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THE VAGARIES OF BERYLLIUM¹

As it has become a custom in the American Chemical Society that the chairmen of the various sections, into which the sessions of the general meetings are divided, shall present an address upon some branch of their work in which they are especially interested, I have decided to speak this morning upon beryllium and especially upon those peculiarities of the element which stand out prominently as characteristic of itself. I realize fully the narrowness of the subject and fear that what I have to say will scarcely be of interest to all of you, but must plead as my excuse that, realizing fully the limitations of my own knowledge, I can select no other subject with which I am more familiar.

Even at its christening beryllium started on a vagarious career and its early sponsors as well as those who followed have recognized it under different names and have ascribed to it and to its compounds properties as widely variant as the conditions under which they worked. Referred to first by Vauquelin, its discoverer, as "la terre du Béril" the German translators naturally adopted Berylerde as the name of its oxide and although Vauquelin later accepted, under virtual protest, the suggestion made that glucine be used on account of the sweetish taste of the salts of the element, the name never secured adoption

¹ Address of the chairman of the Section on Inorganic Chemistry, Toronto Meeting, American Chemical Society.

outside of France and in the early literature was frequently written glycine. When later the element itself was separated by Wohler he used the term beryllium for the first time and a few weeks after glucinium appeared in the French press due to Bussy's almost simultaneous discovery. It is useless to go into the subsequent usage of the term or why the "i" was dropped and glucinum used for a time in American practise. It is sufficient, I think, to say that by far the majority of chemists of the world prefer and use the name beryllium in their conversation and writings, and since neither priority nor usage can be shown for glucinium it should be dropped as rapidly as possible in the interests of uniformity. I especially believe this to be true since there is no prospect of its ever replacing the more popular and, in my opinion, more justifiable beryllium.

Although the literature of inorganic chemistry is quite generally overburdened with compounds which have no actual existence and which have obtained place and been assigned formulas simply by the *analysis* of solid phases obtained under variable conditions and without other attempt to prove their individuality, it is doubtful if there is any branch of the field that needs more careful revision than the chemistry of beryllium. Its literature is full of errors. Compound after compound has been claimed which has no actual individual existence, but whose place in literature and whose formula depend solely upon analysis of mixed crystals, residues of evaporation or indefinite gummy precipitates, without attempt to separate the individuals present. Formerly this could not always be done, but with the more recent and simple applications of the phase rule to these problems there is no excuse for similar errors which, unfortunately, still continue to creep into our journals.

The metal beryllium itself has been but

little studied, and for the main part simply as a dark steel-gray powder obtained by the reduction of its chloride by sodium or potassium or as small hexagonal plates obtained by the electrolysis of its double fluorides in a manner quite similar to the production of aluminum. Its melting point, its solution tension and many others of its important properties have never been determined, and many diverse statements are to be found in regard to it, although the very careful researches of Lebeau can undoubtedly be fully relied upon so far as he went into the subject. It is recorded, for example, that it does and it does not combine directly with hydrogen, sulphur, selenium and phosphorus, that it is and it is not reduced from its oxide by aluminum and magnesium, that it has been produced (even manufactured) by the electrolysis of its bromide and that its bromide is not a conductor of electricity. In each case the negative is probably true. For many years its valency was, and, for that matter, still is a matter of dispute. Even before it was seen that the only vacant place for beryllium in the periodic system was between lithium and boron, there were strong arguments for both its divalency and its trivalency on account of its close resemblance to both zinc and aluminum in its action. When Mendeléef finally pointed out its proper place in his table the controversy grew even more animated and most of the researches on the element in the seventies and eighties had the establishment of the true valency as the main object. All the early determinations of the specific heat lead to the figure 13.6 as the atomic weight and it was not until Nilson and Pettersson, after conquering unusual difficulties in a masterly research, finally determined the vapor density of the chloride and established its formula as BeCl_2 that real light was thrown on the problem. Shortly afterward in 1886 Humpidge showed that beryllium was abnormal as to its specific

heat, which increased regularly with the temperature at which determined, until between 400° and 500° it approached normal with a value of 6.2. A determination of the vapor density of the bromide, of the acetylacetate and of the basic acetate, all seemingly in agreement with the idea of the divalency of the element, would have seemed to have settled the matter and probably has done so, but the controversy itself goes merrily on. Wyruboff still argues in his articles for the trivalency and Tanatar claims that the basic acetate can only be explained on the supposition that the element is in reality tetravalent.

Of the binary compounds of beryllium only the oxide, the carbids and the halides have any real standing in literature, although the sulphide has been made by Lebeau. Of these the oxide is the only one that is stable in ordinary moist air and even it shows decided variability in its hydroscopicity for reasons not yet determined. Ordinarily white, it is said to be blue by Levi-Malvano when made from his hexahydrated sulphate, although it is almost inconceivable that the difference of two molecules of water in the sulphate should cause this change and the existence of the hexahydrate itself is not yet confirmed. The halides, with the possible exception of the fluoride, can only exist in the complete absence of water, which causes them immediately and violently to lose part of their anion as hydracid. In this respect they are even more sensitive than the corresponding compounds of aluminum. On evaporating their solutions in water they lose more or less of the remainder of the gaseous hydracids, the residue becoming more and more basic and remaining soluble until a surprising degree of basicity is reached. This hydrolytic action is comparatively small in the case of the fluoride, but is practically complete in the case of the chloride, bromide and iodide. By care-

ful manipulation residues of almost any degree of basicity, up to the pure oxide, can be obtained, and these mixtures of base and normal salt have given rise to claims for numerous *oxyfluorids* and *oxychlorides* for the existence of which there is no other evidence than the analysis of the variable residues obtained.

The hydroxide of beryllium is one of the most interesting of its compounds and one that has properties which vary greatly with the conditions of its preparation. Among the most noteworthy may well be mentioned its great solubility, of from two to five equivalents, in concentrated solutions of its own salts, and its precipitation therefrom on dilution; its solubility in saturated solutions of acid sodium and ammonium carbonates, and its very much diminished susceptibility to reagents when dried at high temperature or boiled in water, as instanced by the fact that when freshly precipitated and washed with cold water it will take up one third of an equivalent of carbon dioxide, but on boiling becomes so immune to its action that the gas has been passed through it for three months without any considerable absorption.

Probably the fact which has the greatest bearing upon the chemistry of beryllium and has caused more failures of researches undertaken upon the element than any other one thing, is the great influence which water has upon all of its salts, acting to many of them almost as if it were itself a strong hydroxide and in a manner that is hard to understand from our ordinary conceptions of solution and hydrolysis.

For this reason normal salts of the non-volatile acids only can be crystallized from water, and indeed but very few of them, such as the sulphate, the selenate and the oxalate have been so prepared. These are so strongly acid in reaction that they act almost as solutions of the acids themselves, attacking metals with evolution of hydro-

gen, setting free carbon dioxide from carbonates and reddening litmus even after surprising quantities of free base have been added. In spite of this fact the sulphate, chloride and nitrate have been shown to be less hydrolyzed, as determined by the sugar inversion method, than the corresponding salts of aluminum and iron, although they attack metals and carbonates vigorously even after many times enough excess of their own hydroxide has been dissolved to throw back the hydrolysis. Other normal salts like the nitrate can be prepared only by crystallizing from concentrated acid, and even anhydrous acid yields only basic compounds in the case of the fatty acid series. Normal salts of more readily volatile acids, like the nitrite and carbonate, have not been produced at all or only, as in the case of the sulphite, from absolute alcohol or, as with the halides, by the direct combination of the elements themselves, with special precautions to eliminate water. Many normal salts, such as the borates, the chlorates, the bromates, the iodates, the chromates, the acetates, etc., have not been obtained, apparently because a concentration of acid sufficient to overcome the so-called hydrolytic solution tension of the salts can not be attained.

On the other hand, only one *acid* salt, the mono acid phosphate, has any real claim for recognition and, although the peculiar nature of phosphoric acid would seem to render the existence of this compound as probable as any of an acid nature, its existence rests solely upon the testimony of a single analysis of a non-crystalline precipitate obtained by Scheffer nearly fifty years ago.

The action of water upon the compounds of beryllium is highly modified, as is the case with some of the compounds of aluminum and magnesium, by the entrance of another metallic element into the molecule, and some of the double salts of this element

are well defined and readily obtained in the presence of water, where the simple normal salt could not be produced at all or only with difficulty. This is notably true of the double carbonates, chlorids, iodides, nitrites and sulphites, although in general these salts have been studied but little, their discoverers being content with their identification and analysis. Among the double salts time permits of the mention only of the truly interesting double alkali tartrates and malates studied by Rosenheim and Itsig, and of the remarkable fact that the introduction of beryllium into their molecule enormously increases the molecular rotation of the compound, so that the diberyllium alkali tartrates have from five to six times the molecular rotation of the corresponding alkali bitartrates, and the diberyllium malates a molecular rotation more than twenty times as great as the alkali bimalates. This is particularly surprising since Walden has shown that beryllium has no undue influence upon the molecular rotation of the alpha brom camphor sulphonates.

Some of the most interesting problems of the chemistry of beryllium lie in the equilibrium relations that exist between the various acid radicals and quantities of the oxide in excess of that required to produce the normal salt, *i. e.*, in the so-called basic compounds. It is certainly true that many of these acids can hold in solution phenomenally large amounts of beryllium oxide or hydroxide, extending in the case of the acetate to six equivalents, while the chloride can hold four, the sulphate three and the oxalate nearly three equivalents. Even after these abnormal amounts have been dissolved the solutions still remain acid to litmus, and if heated in contact with basic beryllium carbonate the carbonate is attacked, the carbon dioxide set free and an equivalent amount of hydroxide thrown out of solution. These highly concentrated

solutions, on being diluted with water, throw down precipitates of a highly basic nature, or on evaporation leave gummy masses, the basicity of which depends upon the amount of the dissolved hydroxide, while, physically, they differ but little. Both the precipitated bodies and the residues of evaporation are amorphous and glassy in structure and vary widely in composition. The basic precipitates on equilibrium, being reached, approach closely to the hydroxide in composition, but always contain a small amount of occluded acid or normal salt, which it is impossible to entirely remove by washing. These facts have given rise in literature to a large number of so-called basic compounds which have no existence as independent individuals, but are in reality the impure hydroxide, or, perhaps, more properly come under the domain of homogeneous phases of variable composition or solid solutions.

It is, indeed, difficult to understand how the solution of the normal sulphate, nitrate and chloride can dissolve several equivalents of their own hydroxide, attack metals and carbonates almost as vigorously as if they were the free acids themselves yielding these basic solutions, and still be less hydrolyzed than the corresponding salts of aluminum and iron as Leys and Brunner have both shown to be the case. It is, perhaps, equally difficult to demonstrate why the basic solutions so obtained should have less osmotic activity per equivalent of the acid present than the normal salts, should show no indication of a colloidal nature and should contain no complex anion, but this is, indeed, the fact. The most probable explanation would seem to be that we have here a case of simple solution of a substance (beryllium hydroxide) in a mixed solvent (water and normal salt) in one of which alone (water) it is insoluble. The whole action of these solutions is perfectly analogous to those cases where a

substance, being dissolved in a mixed solvent, *raises* the freezing point whenever it is insoluble in that component which separates as the solid phase on cooling and which Miller has mathematically shown is a necessary sequence of the theorem of Gibbs.

In contradistinction to the basic solutions, solid or liquid, already mentioned, we have the truly phenomenal and actually basic compounds of beryllium, discovered in Urbain's laboratory by Lacombe, which are produced pure only in contact with anhydrous acid or acid so nearly anhydrous that the mass of the water present becomes negligible to produce hydrolysis. These very interesting, volatile and perfectly unique basic compounds are apparently confined to the fatty acid series and have the general formula $\text{Be}_4\text{O}(\text{AC})_6$. Of these the formate, acetate, propionate, butyrate, isobutyrate and isovalerianate have been made and studied.

And now after this brief summary of the main characteristics of the chief classes of beryllium compounds I must, in closing, honor those who have been most prominent in developing our knowledge of this element by mentioning the names of Vauquelin, Wöhler, Bussy, Andejew, Weeren, Debray, Joy, Gibbs, Atterberg, Nilson and Pettersson, Humpidge, Hartly, Krüss and Moraht, Lebeau, Rosenheim and Itsig, and Urbain and Lacombe and paying my sincere respect to the many others who, from time to time, have struggled through the difficulties incident to the peculiar and decidedly vagarious action of this element to greater light and truth. And finally I feel that I should call the attention of this inorganic section most particularly to the fact that not only the future chemistry of beryllium, but of all the elements in our branch of the greatest of sciences, is becoming more and more dependent for its exactness and wealth of discovery upon the

application of those laws which are now correlated under the head of physical chemistry. At the same time we must not be engulfed by this more recent branch of our science, but must always look to her as the handmaiden and not the mistress.

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*THE APPLICATION OF SCIENTIFIC METHOD
TO EDUCATIONAL PROBLEMS*¹

NOTWITHSTANDING the fact that the greater part of my life has been spent in educational work, in teaching, in examining, in organization, and in the investigation of foreign systems of instruction, I have experienced considerable difficulty in selecting, from the large number of subjects that crowd upon me, a suitable one on which to address you as president of a section of the British Association devoted to educational science.

At the outset I am troubled by the title of the section over which I have the honor to preside. I can not refrain from asking myself the question, Is there an educational science, and if so, what is its scope and on what foundations does it rest? The object of the British Association is the advancement of science, and year by year new facts are recorded in different branches of inquiry, on which fresh conclusions can be based. The progress of past years, whether in chemistry, physics or biology, can be stated. Can the same be said, and in the same sense, of education? It is true that the area of educational influence is being constantly extended. Schools of every type and grade are multiplied, but is there any corresponding advance in our knowledge of the principles that should govern and determine our educational efforts, or which can justify us in describing such

knowledge as science? If we take science to mean, as commonly understood, organized knowledge, and if we are to test the claim of any body of facts and principles to be regarded as science by the ability to predict, which the knowledge of those facts and principles confers, can we say that there exists an organized and orderly arrangement of educational truths, or that we can logically, by any causative sequence, connect training and character either in the individual or in the nation? Can we indicate, with any approach to certainty, the effects on either the one or the other of any particular scheme of education which may be provided? It is very doubtful whether we can say that educational science is yet sufficiently advanced to satisfy these tests.

But although education may not yet fulfil all the conditions which justify its claim to be regarded as a science, we are able to affirm that the methods of science, applicable to investigations in other branches of knowledge, are equally applicable to the elucidation of educational problems. To have reached this position is to have made some progress. For we now see that if we are ever to succeed in arriving at fixed principles for guidance in determining the many difficult and intricate questions which arise in connection with the provision of a national system of education, or the solution of educational problems, we must proceed by the same methods of logical inquiry as we should adopt in investigating any other subject matter.

In order to bring education within the range of subjects which should occupy a place in the work of this association, our first efforts should be directed towards obtaining a sufficient body of information from all available sources, past and present, to afford data for the comparisons on which our conclusions may be based. One

¹Address of the president of the Educational Science Section of the British Association for the Advancement of Science, Leicester, 1907.

of the five articles of what is known as the Japanese Imperial Oath states, "Knowledge shall be sought for throughout the whole world, so that the welfare of the empire may be promoted"; and it may certainly be said that, as the welfare of our own empire is largely dependent on educational progress, a wide knowledge of matters connected with education is indispensable, if we are to make advances with any feeling of certainty that we are moving on the right lines.

There can be no doubt that of late years we have acquired a mass of valuable information on all sorts of educational questions. We are greatly indebted for much of our knowledge of what is being done in foreign countries to the reports of different commissions, and more particularly to those special reports issued from the board of education, first under the direction of my predecessor in this chair, Professor Sadler, and latterly of his successor at the board, Dr. Heath. But much of the information we have obtained is still awaiting the hand of the scientific worker to be properly coordinated and arranged. A careful collation of facts is indispensable if we are to deduce from them useful principles for our guidance, and unfortunately we in this country are too apt to rest content when we have provided the machinery for the acquisition of such facts without taking the necessary steps to compare, to coordinate, and to arrange them on some scientific principle for future use. Within the last week or two a bill has passed through several stages in parliament for requiring local authorities to undertake the medical inspection of school children, but, unless the medical inspectors throughout the country conduct their investigations on certain well-considered lines laid down for them by some central authority, we shall fail to obtain the necessary data to enable us to associate educational and physical

conditions with a view to the improvement of the training given in our schools.² On the other hand, although I personally am sceptical as to the results, we have reason to believe that the inquiry recently undertaken into the methods adopted here and elsewhere for securing ethical as distinct from specifically religious training will be so conducted as to give us not only facts, but the means of inferring from those facts certain trustworthy conclusions.

The consideration of education as a subject capable of scientific investigation is complicated by the fact that it necessarily involves a relation—the relation of the child or adult to his surroundings. It can not be adequately considered apart from that relation. We may make a study of the conditions of the physical, intellectual, and ethical development of the child, but the knowledge so obtained is only useful to the educator when considered in connection with his environment and future needs, and the means to be adopted to enable him, as he grows in physical, intellectual and moral strength, to obtain a mastery over the things external to him. Education must be so directed as to prove the proposition that "knowledge is power." It can only be scientifically treated when so considered. Education is imperfectly described when regarded as the means of drawing out and strengthening a child's faculties. It is more than this. Any practical definition takes into consideration the social and economic conditions in which the child is being trained, and the means of developing his faculties with a view to the attainment of certain ends.

² Since this was written the president of the Board of Education has stated in the House of Commons that "it was the intention of the board, if the bill now before parliament passed, to establish a medical bureau, which would guide and advise the local authorities as to the nature of the work they would have to do under the act."

It is in Germany that this fact has received the highest recognition and the widest application, and for this reason we have been accustomed to look to that country for guidance in the organization of our schools. We have looked to Germany because we perceived that some relation had been there established between the teaching given to the people and their industrial and social needs; and further, that their success in commerce, in military and other pursuits was largely due to the training provided in their schools. Unmindful of the fact that education is a relation, and that consequently the same system of education is not equally applicable to different conditions, there were many in this country who were only too ready to recommend the adoption of German methods in our own schools. Experience soon showed, however, that what may have been good for Germany did not apply to England, and that, in educational matters certainly, we do well to follow Emerson, who when addressing his fellow citizens, declared: "We will walk on our own feet; we will work with our own hands, and we will speak our own minds." Still, the example of Germany and the detailed information which we have obtained as to her school organization and methods of instruction have been serviceable to us.

Whilst all information on educational subjects is valuable, I am disposed to think that in our efforts to construct an educational science we may gain more by inquiring what has been effected in some of the newer countries. Wherever educational problems have been carefully considered and schemes have been introduced with the express intention and design of training citizens for the service of the state and of increasing knowledge with a view to such service, those schemes may be studied with advantage. Thus we may learn much from what is now being done

in our colonies. Their efforts are more in the nature of experiments. Our colonies have been wise enough not to imitate too closely our own or any foreign system. They have started afresh, free from prejudice and traditions, and it is for this reason that I look forward with interest to the closer connection in educational matters of the colonies with the mother country, and I believe that we shall gain much knowledge and valuable experience from the discussions of the Federal Conference which has recently been held in London, and which, I understand, is to be repeated a few years hence.

But valuable as are the facts, properly collated and systematically arranged, which a knowledge of British and foreign methods may afford us in dealing scientifically with any educational problem, it is essential that we should be able to test and to supplement the conclusions based on such knowledge, whenever it is possible, by direct experiments, applicable to the matter under investigation. We have not yet recognized the extent to which experiments in education, as in other branches of knowledge, may help in enabling us to build up an educational science. Some years since there was established in Brussels an *Ecole modèle* in which educational experiments were tried. I visited the school in the year 1880, and I could easily point to many improvements in primary education which found their way from that school through the schools of Belgium and France to our own country, and, indeed, to other parts of the world. From a special report on schools in the north of Europe, recently published by the board of education, we learn that in Sweden the value of such experiments is fully recognized. We are told that in that country "it was early felt that the uniformity in state schools was of so strict a kind that some special provision should be made for

carrying out educational experiments," and experiments in many directions have been made, mainly in private schools, which receive, however, special subventions from the state. We gather from the same report that the state regards the money as well earned "if the school occasionally originates new methods from which the schools can derive profit." I venture to think that experimental schools might with advantage be organized under the direction of some of our larger local authorities. The children would certainly not suffer by being made the subjects of such experiments. The intelligent teaching which they would receive—for it is only the most capable teachers who should be trusted with such experiments—would more than compensate for any diminution in the amount of knowledge which the children might acquire, and indeed such experimental schools might be conducted under conditions which would ensure sound instruction. Many improved methods of teaching are constantly advocated, but fail to be adopted because there is no opportunity of giving them a fair trial. As a general rule it is only by the effort of private individuals or associations that changes in system are effected, and teachers are enabled to escape from the old grooves on to new lines of educational thought and practise. It is not difficult to refer to many successful experiments. The general introduction into our schools of manual training was the direct result of experiments carefully arranged and conducted by a joint committee of the city guilds and the late London School Board. Experiments in the methods of teaching physical science, chemistry and geometry have been tried, with results that have led to changes which have revolutionized the teaching of those subjects. The age at which the study of Latin should be commenced with a view to the general educa-

tion of the scholar has been the subject of frequent trial. I would like to see such experiments more systematically organized, and I am quite certain that the curriculum of our rural and of our urban schools would soon undergo very considerable changes, if the suggestions of competent authorities could receive a fair trial under conditions that would leave no manner of doubt as to the character of the results.

It would seem, therefore, that if our knowledge of the facts and principles of education is not yet sufficiently organized to enable us to determine *a priori* the effect on individual or national character of any suggested changes, education is a subject that may be studied and improved by the application to it of scientific method, by accurate observation of what is going on around us, and by experiments thoughtfully conducted. This is the justification of the inclusion of the subject among those that occupy the attention of a separate section of this association. Our aim here should be to apply to educational problems the well known canons of scientific inquiry; and, seeing that the conditions under which alone any investigation can be conducted are in themselves both numerous and complicated, it is essential that we should endeavor to liberate, as far as possible, the discussion of the subject from all political considerations. Such investigations are necessarily difficult. We have to determine both statically and dynamically the physical, mental and moral condition of the child in relation to his activities and surroundings, and we have further to discover how he is influenced by them, how he can affect them, and the character of the training which will best enable him to utilize his experiences, and to add something to the knowledge of to-day for future service.

Notwithstanding the undoubted progress

which we have made, it can not be denied that in this country there still exists a large amount of educational unrest, of dissatisfaction with the results of our efforts during the last thirty years. This is partly due to the fact that there is much loose thinking and uninformed expression of opinion on educational questions. No one knows so little as not to believe that his own opinion is worth as much as another's on matters relating to the education of the people. In this way statements, the value of which has not been tested, pass current as ascertained knowledge, and very often ill-considered legislation follows. In this country, too, the difficulty of breaking away from ancient modes of thought is a great drawback to educational progress. Suggestions for moderate changes, which have been most carefully considered, are deferred and decried if they depart, to any great extent, from established custom, and the objection to change very often rests on no historical foundation. Occasionally, too, the change proposed is itself only a reversion to a previous practice, which was rudely broken by thoughtless and unscientific reformers. The opposition which was so long raised to the establishment of local universities was largely due to want of knowledge on the subject; and certainly the creation, some seventy years ago, of a teaching university in London was actually hindered through a mere prejudice, which broader views as to the real purposes of university teaching and fuller information on the course of university development would have removed.

There never was a time perhaps when it was more necessary than now that education should be regarded dispassionately, apart from political bias, as a matter of vital interest to the people as a whole. Education nowadays is a question which affects not only the life of a few privileged,

selected persons, but of the entire body of citizens. The progress that has been made during the last few years in nationalizing our education has been very rapid. It may be that it has been too rapid, that sufficient thought has not been given to the altered social and industrial conditions which have to be considered. We have witnessed a strong desire and a successful effort to multiply secondary and technical schools and to open more widely the portals of our universities. The object of the desire is good in itself. As the people grow in knowledge the demand for higher education will increase; but the serious question to be considered is whether the kind of education which was supplied in schools, founded centuries ago to meet requirements very different from our own, is equally well adapted to the conditions which have arisen in a state of society having other needs and new ideals. Very rightly our students in training for the profession of teachers are expected to study the writings of Locke, Rousseau, Milton, Montaigne and others; but many are apt to overlook the fact that these writers had in view a different kind of education from that in which modern teachers are engaged, and that their suggestions, excellent as many of them are, were mainly applicable to the instruction to be given by a tutor to his private pupil, and had little or no reference to the teaching of the children of the people in schools expressly organized for the education of the many. Only recently have we come to realize that a democratic system of education, a system intended to provide an intellectual and moral training for all citizens of the state, and so organized that, apart from any consideration of social position or pecuniary means, it affords facilities for the full development of capacity and skill wherever they may occur, must be essentially different in its aims and

methods from that under which many of us now living have been trained. It has also been brought home to us that the marvelous changes in our environment, in the conditions under which we live and work, whether in the field, the factory or the office, have necessitated corresponding changes in the education to be provided as a preparation for the several different pursuits in which the people generally are occupied. Yet, notwithstanding these great forces which have broken in upon and disturbed our former ideals, forces the strength and far-reaching effects of which we readily admit, we still hesitate to face the newly arisen circumstances and to adapt our educational work to its vastly extended area of operation and to the altered conditions and requirements of modern life.

When I say we hesitate to face the existing circumstances I do not wish to be misunderstood. As a fact changes are continually being discussed, and are from time to time introduced into our schools. But such modifications of our existing methods are generally isolated and detached, and have little reference to the more comprehensive measures of reform which are now needed to bring our teaching into closer relation with the changed conditions of existence consequent on the alterations that have taken place in our social life and surroundings.

Four years ago, it will be remembered, a committee of this section was appointed to consider and to report upon the "Courses of Experimental, Observational and Practical Studies most Suitable for Elementary Schools." That committee, of which I had the honor to be chairman, presented a report to this section at the meeting of the association held last year at York. The general conclusion at which they arrived was that "the intellectual and moral training, and indeed to some extent the phys-

ical training, of boys and girls between the ages of seven and fourteen would be greatly improved if active and constructive work on the part of the children were largely substituted for ordinary class teaching, and if much of the present instruction were made to arise incidentally out of, and to be centered around, such work." It is too early, perhaps, to expect that the suggestions made in that report should have borne fruit, but I refer to it because it illustrates the difference between the spasmodic reforms which from time to time are adopted, under pressure from bodies of well-meaning representatives of special interests, and the well-considered changes recommended by a committee of men and women of educational experience who have carefully tested the conclusions at which they have arrived.

There can be no doubt that, as regards our elementary education, there is very general dissatisfaction with its results, since it was first nationalized thirty-seven years ago. Our merchants and manufacturers and employers of labor, our teachers in secondary and technical schools all join in the chorus of complaint. They tell us that the children have gained very little useful knowledge and still less power of applying it. There is enough in this general expression of discontent to give us pause and to make us seek for a rational explanation of our comparative failure. The inadequacy of the results attained to the money and effort that have been expended is in no way due to any want of zeal or ability on the part of the teachers, or of energy on the part of school boards or local authorities. They have all discharged the duties which were imposed upon them. It is due rather to the fact that the problem has been imperfectly understood, that our controlling authorities have had only a vague and indistinct idea of the aim and end of the important

work which they were charged to administer. If we look back upon the history of elementary education in this country since 1870, we can not fail to realize how much its progress has been retarded by errors of administration due very largely to the want of scientific method in its direction. It is painful to reflect, for instance, on the waste of time and effort, and on the false impressions produced as to the real aim and end of education, owing to the system of payment on results, which dominated for so many years a large part of our educational system. We must remember that it is only within the last few decades that education has been brought within reach of all classes of the population. Previously it was for the few; for those who could pay high fees; for those who were training for professional life, whether for the church, the army, the navy, law or medicine, or for the higher duties of citizen life. This had been the case for centuries, not only in this country but in nearly all parts of the civilized world. If we read the history of education in ancient Greece or Rome, or mediæval Europe, we shall see that popular education, as now understood, was unknown. All that was written about education applied to the few who got it, and not to the great mass of the people engaged in pursuits altogether apart from those in which the privileged classes were employed. Trade and manual work were despised, and were considered degrading and unworthy of the dignity of a gentleman. I need scarcely say that these social ideas are no longer held. The fabric of society is changed, and we have to ask ourselves whether the methods of education have been similarly changed, whether they have been wisely and carefully adapted to the new order of things. What is it that has really happened? Is it not true that we have annexed the methods and subjects of

teaching which had been employed during many centuries in the training of the few and applied them to the education of the people as a whole—to those who are engaged in the very callings which were more or less contemned? Surely it is so, and the results are all too manifest. We have applied the principles and methods of the secondary education of the middle ages to our new wants, to the training of the people for other duties than those to which such education was considered applicable, and it is only within the last few years that we have begun to see the error of our ways. In the report of your committee, to which I have referred, it is pointed out that the problem of primary education has been complicated by the introduction of the methods which for many years prevailed in secondary schools, and at a meeting of the National Education Association, held only a few weeks since, it was truly said: "In this country secondary education preceded primary by several centuries, and so the nation now finds itself with the aristocratic cart attempting to draw the democratic horse."

Let it not be supposed that in the days not so far distant, yet stretching back into the remote past, the people as a whole were uneducated. This was not so. But we have to widen the meaning of education to include the special training which the people then received—an education that was acquired without even the use of books. It can not for one moment be said that the artisans, the mechanics, the farm hands, male and female, were wholly uneducated in those far-off days. In one sense possibly they were. Very few of them could read or write. But from earliest childhood they had received a kind of training the want of which their descendants have sadly felt in the cloistered seclusion of the modern elementary school. They were brought face to face with

nature. They learned the practical lessons of experience; and as they grew up their trade apprenticeship was an education which we have been trying vainly to reproduce. They gained some knowledge of the arts and sciences, as then understood, underlying their work. Their contact with their surroundings made them thoughtful and resourceful, for nature is the most exacting and merciless of teachers. The difficulties they had to overcome compelled them to think, and of all occupations none is more difficult. They were constantly putting forth energy, adapting means to ends, and engaging in practical research. In the field, in the workshop, and in their own homes boys and girls acquired knowledge by personal experience. Their outlook was broad. They learned by doing. It is true that nearly all their occupations were manual, but Emerson has told us, "Manual training is the study of the external world."

Compare for a moment this training with that provided in a public elementary school, and you can not be surprised to find that our artificial teaching has failed in its results, that our young people have gained very little practical knowledge, and that what they have gained they are unable to apply; that they lack initiative and too often the ability to use books for their own guidance, or the desire to read for self-improvement. We seem to have erred in neglecting to utilize practical pursuits as the basis of education, and in failing to build upon them and to evolve from them the mental discipline and knowledge that would have proved valuable to the child in any subsequent occupation or as a basis for future attainments. We have made the mistake of arresting, by means of an artificial literary training, the spontaneous development of activity, which begins in earliest infancy and continues to strengthen as the child is brought into ever closer con-

tact with his natural surroundings. We have provided an education for our boys which might have been suitable for clerks; and, what is worse, we have gone some way, although we have happily cried a halt, to make our girls into "ladies," and we have run some risk of failing to produce women.

If we are to correct the errors into which we have drifted, if we are to avert the consequences that must overtake us through having equipped our children for their life-struggle with implements unfitted for their use, we must consider afresh the fundamental ideas on which a system of elementary education should be based. Instead of excluding the child from contact with the outer world we must bring him into close relationship with his surroundings. It was given to man to have dominion over all other created things, but he must first know them. It is in early years that such knowledge is most rapidly acquired, and it is in gaining it that the child's intellectual activities are most surely quickened.

It is unfortunate that we failed to realize this great function of elementary education when we first essayed to construct for ourselves a national system. The three R's, and much more than that, are essential and incidental parts of elementary education. But what is needed is a *Leitmotif*—a fundamental idea underlying all our efforts and dominating all our practise, and I venture to think that that idea is found in basing our primary education on practical pursuits, on the knowledge gained from actual things, whether in the field, the workshop or the home.

Instead of fetching our ideas as to the training to be given in the people's schools from that provided in our old grammar schools, we should look to the occupations in which the great mass of the population

of all countries are necessarily engaged, and endeavor to construct thereon a system with all such additions and improvements as may be needed to adapt it to the varied requirements of modern life. By this process—one of simple evolution adjusted to everyday needs—a national system of education might be built up fitted for the nation as a whole—a system founded on ideas very different from those which, through many centuries, have governed the teaching in our schools. In the practical pursuits connected with the field, the workshop and the home, and in the elementary teaching of science and letters incidental thereto, we might lay the foundation of a rational system of primary education.

These three objects—the field, the workshop and the home—should be the pivots on which the scheme of instruction should be fixed, the central thoughts determining the character of the teaching to be given in rural and urban schools for boys and girls. It was Herbart who insisted on the importance of creating a sort of center around which school studies should be grouped with a view to giving unity and interest to the subjects of instruction. I have elsewhere shown how a complete system of primary education may be evolved from the practical lessons to be learned in connection with out-door pursuits, with workshop exercises and with the domestic arts, and how, by means of such lessons, the child's interest may be excited and maintained in the ordinary subjects of school instruction, in English, arithmetic, elementary science and drawing. In the proposals I am now advocating I am not suggesting any narrow or restricted curriculum. On the contrary, I believe that, by widening the child's outlook, by closely associating school work with familiar objects, you will accelerate his mental development and quicken his power of acquiring knowledge. I would strongly

urge, however, that the child should receive less formal teaching, that opportunities for self-instruction, through out-door pursuits, or manual exercises, or the free use of books, should be increased, so that as far as possible the teacher should keep in view the process by which in infancy and in early life the child's intelligence is so rapidly and marvelously stimulated. Already we have discovered that our unscientific attitude towards primary education has caused us to overlook the essential difference between the requirements of country and of town life, and the training proper to boys and girls. Our mechanical methods of instruction, as laid down in codes, make for uniformity rather than diversity, and we are only now endeavoring, by piecemeal changes, to bring our teaching somewhat more closely into relation with existing needs. But the inherent defect of our system is that we have started at the wrong end, and, instead of evolving our teaching from the things with which the child is already familiar, and in which he is likely to find his life's work, we have taken him away from those surroundings and placed him in strange and artificial conditions, in which his education seems to have no necessary connection with the realities of life.

The problem of primary education is to teach by practical methods the elements of letters and of science, the art of accurate expression, the ability to think and to control the will; and the ordinary school lessons should be such as lead to the clear apprehension of the processes that bring the child into intimate relation with the world in which he moves. During the last few years the importance of such teaching has dimly dawned upon our educational authorities, but, instead of being regarded as essential, it has been treated as a sort of *extra* to be added to a literary curriculum, already overcrowded. What is

known as manual training is to some extent encouraged in our schools, but it forms no part of the child's continuous education. It is still hampered with conditions inconsistent with its proper place in the curriculum, and is uncoordinated with other subjects of instruction. Moreover no connecting link has yet been forged between the teaching of the kindergarten and workshop practise in the school. We speak of lessons in manual training as something apart from the school instruction, as something outside the school course, on the teaching of which special grants are paid. Twenty or thirty years ago people used to talk about "teaching technical education," and from this unscientific way of treating the close connection that should exist between hand-work and brain-work our authorities have not yet freed themselves.

It is true we have long since passed that stage when it was thought that the object of instruction in the use of tools was to make carpenters or joiners; but, judging from a report recently issued by the board of education, it would seem that it is still thought that the object of cookery lessons to children of twelve to fourteen years of age is the training of professional cooks. Until the board's inspectors can be brought to realize that the aim and purpose of practical instruction in primary schools, whether in cookery or in other subjects, is to train the intelligence through familiar occupations, to show how scientific method may be usefully applied in ordinary pursuits, and how valuable manipulative skill may thus be incidentally acquired, it does not seem to me that they themselves have learned the most elementary principles of their own profession. An anonymous teacher, writing some weeks since in the *Morning Post*, said:

The cookery class can be made an invaluable mental and moral training ground for the pupils, the most stimulating part of primary education.

It teaches unforgettable lessons of cleanliness and order, of quickness and deftness of movements. The use of the weights and scales demands accuracy and carefulness, and the raw materials punish slovenliness or want of attention with a thoroughness which the most severe of schoolmasters might hesitate to use. Practical lessons in chemistry should form an important feature of each class. . . . The action of heat and moisture on grains of rice provides an interesting lesson on the bursting of starch cells, and the children's imagination is awakened by watching the hard isolated atoms floating in milk change slowly to the creamy softness of a properly made rice pudding. The miraculous change in the oily white of egg when it is beaten into a mountain of snowy whiteness gives them interest in the action of air and its use in cookery.

Can the teaching of grammar or the analysis of sentences provide lessons of equal value in quickening the intelligence of young children?

I must add one word before passing from this suggestive illustration of the value of scientific method in the treatment of educational questions. We live in a democratic age, and any proposed reform in the teaching of our primary schools must be tested by the requirement that the revised curriculum shall be such as will provide not only the most suitable preparatory training for the occupations in which four fifths of the children will be subsequently engaged, but will, at the same time, enable them or some of them to pass without any breach of continuity from the primary to the secondary school. There must be no class distinctions separating the public elementary from the state-aided secondary school. The reform I have suggested is unaffected by such criticism. The practical training I have advocated, whether founded on object lessons furnished by the field, the workshop or the home, would prove the most suitable for developing the child's intelligence and aptitudes and for enabling him to derive the utmost advantage from attendance at any one of the different types of

secondary schools best fitted for his ascertained abilities and knowledge. The bent of the child's intellect would be fully determined before the age when the earliest specialization would be desirable. No scheme of instruction for primary schools can be regarded as satisfactory, which is not so arranged that, whilst providing the most suitable teaching for children who perforce must enter some wage-earning pursuit at the age of fourteen, or at the close of their elementary school course, shall at the same time afford a sound and satisfactory basis on which secondary and higher education may be built. And I hold the opinion, in which I am sure all teachers will concur, that a scheme of primary education pervaded by the spirit of the kindergarten which, by practical exercises, encourages observation and develops the reasoning faculties, and creates in the pupil an understanding of the use of books, would form a fitting foundation for either a literary or a scientific training in a secondary school.

I have purposely chosen to illustrate the main subject of this address by reference to defects in our primary instruction, because the success of our entire system of education will be found, year by year, to depend more and more upon the results of the training given in our public elementary schools. We have scarcely yet begun to realize the social and political effects of the momentous changes in our national life, consequent on the first steps which were taken less than forty years ago to provide full facilities under state control and local management for the education of the people.

At present all sorts of ideas are afloat which have to be carefully and scientifically considered. The working classes have to be further and somewhat differently educated, in order that they may better understand their own wants and how they are

to be satisfied. We have placed vast powers in the hands of local bodies, popularly elected, powers not only of administration, for which they are well adapted, but powers of determining to a very great extent, by the free use of the rates, the kind of instruction to be given in our schools, and the qualifications of the teachers to impart it. Moreover, these local bodies have shown, in many instances, a distrust of expert advice and a desire to act independently as elected representatives of the people, which can not fail for some time at least to lead to waste of effort and of means. It was said years ago, when the center of our political forces received a marked displacement, that we must educate our masters. Our masters now, both in politics and education, are the people, and it is only, I believe, by improving their education that we can enable them to understand the essential difficulties of the problems which they are expected to solve, and can induce them to rely, to a greater extent than they do at present, on the results of the application to such problems of scientific method, founded on the fullest information obtainable from historical and contemporary sources.

I might have illustrated my subject by reference to the acknowledged chaotic condition of our secondary education. In the report of the board of education published in December last we read:

While the development of secondary education is the most important question of the present day, and is the pivot of the whole education as it affects the efficiency, intelligence and well-being of the nation, yet its present position may be described as "chaos."

The "chaos" by which the present position of our secondary education is here described is intimately connected with the questions relating to primary education, which I have been engaged in considering. If we construct a system of primary education which serves equally for children of

all classes, apart from social conditions—a system educationally sound, both as a preparation for immediate wage-earning pursuits and for more advanced and somewhat more specialized training in a secondary school, many of the difficulties which confront the board of education, and which are largely of an administrative order, would disappear. The difficulties are in part dependent on the question of curriculum, to the discussion of which a day will be devoted during the present meeting.

University education in this country, and indeed in other countries, has also suffered much from the hands of the unscientific reformer. In Germany, owing to many causes, the higher education has made considerable advances during the past century; but, even in that country, a more critical study of the development of university education and a truer recognition of the twofold function of a university might have prevented the early separation in distinct institutions and under separate regulations of the higher technical from university instruction. Only within recent years has France retraced her steps and returned to the university ideal of seven centuries ago. But perhaps the climax of unscientific thinking was reached in the scheme, happily abandoned, of founding a new university in Dublin on the lines suggested by Mr. Bryce in his now famous speech of January last.

Our conception of the functions of a university has undergone many violent changes. Between the ideal of the University of London prior to its reorganization and that of a medieval university, in which students were never plucked, obtaining their degrees whether they did their work well or badly, there have been many variations; but I think it may be said that, recently at any rate, we have come to realize the fact that our universi-

ties, to fulfil their great purpose, must be schools for the preparation of students for the discharge of the higher duties of citizenship and professional life, and institutions for the prosecution of research, with a view to the promotion of learning in all its branches, and that examinations for degrees, necessary, as they undoubtedly are, as tests of the extent of a student's acquired knowledge, must be regarded as subordinate to these two great functions.

I will not detain you longer. I have endeavored to show under what limitations education may lay claim to be included among the sciences, and how a knowledge of the history of education and the application of the methods of scientific inquiry may help in enabling us to solve many of the intricate and complicated questions which are involved in the establishment on a firm foundation of a national system of education. I have taken my illustrations mainly from the reform of elementary, or, as I prefer to call it, primary education, and I have sought to indicate some of the errors into which we may fall when we fail to apply to the consideration of the problem the same principles of inductive inquiry as are employed in all investigations for the attainment of truth.

I believe that this section of the British Association has the opportunity of rendering a great service to the state. Numerous educational societies exist, in which questions of importance are discussed, and all, perhaps, do useful work. But none is so detached from separate and special interests; none stands so essentially apart from all political considerations; none is so competent to discuss educational problems from the purely scientific standpoint as are the members of this association. If, in the remarks I have offered, somewhat hastily prepared under the pressure of many different kinds of work, I have contributed anything to the solution of a problem, the

difficulty and national importance of which all will admit, I shall feel that I have not been altogether unworthy of the honor of occupying this chair.

PHILIP MAGNUS

SCIENTIFIC BOOKS

Report on the Diatoms of the Albatross Voyages in the Pacific Ocean, 1888-1904. By ALBERT MANN. Assisted in the bibliography and citations by P. L. RICKER. Contributions from the United States National Herbarium, Vol. X., Part 5. Washington, Government Printing Office. 1907.

According to the author, the object of this report is, first, to contribute to the systematic study of the diatoms, and, second, to call attention to the value of further investigations in this field for throwing light upon certain meteorological and geological problems connected with marine investigations. There also has been prepared a set of carefully identified specimens of all the species enumerated, including types of all new species, which collection has been deposited in the United States National Museum. On account of the inadequate methods used in making the gatherings from the *Albatross*, the number of species listed is not nearly so great as might be expected. In fact, considering the large number of soundings and dredgings made and the years over which the work extends, the results are disappointing. It seems unfortunate that the amount of energy and time necessary to properly examine gatherings of this kind should have to be wasted upon barren samples, when the adoption of other methods would have undoubtedly resulted in rich hauls of diatoms. Critical notes upon some three hundred species, thirty-seven of which are new, are given and a sufficiently full discussion of the fifty odd genera concerned is included. The account of the species discussed is considerably more than a mere list, and is of such worth that one regrets all the more the limitations which have been put upon the work. A most careful comparison of the views of various authorities upon each species has been made and should do much towards giving a

really clear conception of the forms discussed. When one considers the inaccessibility of a large amount of the literature upon the diatoms, it seems probable that this part of the report will be one of the most helpful features.

While it may not have been practicable under the circumstances to prepare an absolutely exhaustive list of the synonymy, there seems to be no reason for the omission of names elsewhere cited, even though "the horde of synonyms would be so great as to become most misleading unless accompanied by extensive explanations." Instead of such a discussion "being quite foreign to the purpose of this report" it would seem to be the very place in which to set forth as fully as might be necessary, the reasons for retaining or rejecting names. Certainly the present chaotic conditions of the nomenclature of the diatoms can not be cleared up so long as this tedious but necessary aspect of the subject is disregarded.

The number of stations from which diatoms were collected was altogether too meager to warrant any generalizations regarding either the origin of the bottom from which they came, or the course of the ocean currents which carried them. However, the importance of planning future work with such an end in view is very properly pointed out and some good examples are given of specific knowledge of this character being obtained from a study of the diatoms of a given region.

It is a satisfaction to know that all of the species reported upon have been permanently mounted in such a way as to make them readily accessible to those who may have occasion to refer to them. Not only is there a series of group slides containing specimens of all the forms gathered in a specific locality, but each species has been mounted separately, and the position definitely indicated so that it may be instantly found under the microscope. The value of such a set of slides can only be appreciated by those who have had to search for a particular species in the heterogeneous mass of diatoms and other organisms with which it is usually mounted.

It appears that Mr. Ricker has not only assisted in the bibliography and citations to diatom literature, but has passed upon the many taxonomic problems involved. The painstaking manner in which this has been done adds greatly to the value of the report.

The new species, together with a few others, are well figured by some very good microphotographs.

GEORGE T. MOORE

Leitfaden für den biologischen Unterricht.
Von K. KRAEPELIN, Direktor des Naturhistorischen Museums in Hamburg. Leipzig und Berlin, B. G. Teubner. 1907.

This little manual forms one of a series devoted to the extension of biological interest and the improvement of teaching in the German schools. Others of the series are devoted explicitly to the teaching of botany and zoology. Of similar import are still others devoted to nature study, for example, "Naturstudien in Wald und Feld"; and "Naturstudien in der Sommerfrische." All of which may be taken as indicative of the broadening and liberalizing movements in education the world over.

This particular book, as its name implies, is devoted to the distinctively biological aspects of nature study, but with reference to the higher schools, as indicated in the full title, "Leitfaden für den Biologischen Unterricht in den Oberen Klassen der Höheren Schulen."

The book comprises something over three hundred pages of well-printed and amply and beautifully illustrated matter. One finds, as the author himself admits, some question as to just where to draw the line of a happy medium between the "Scylla" of too much, and the "Charybdis" of too little; and to the reviewer it seems as if the former rock had been barely missed. At any rate, for American high schools we should regard of doubtful educational value the introduction of the intricate problems of prehistoric man and archeology. It must be said, however, that these are touched upon in the present book in only a very elementary manner.

Something of the scope of the book may be

gathered from the following partial glimpse of the table of contents.

First Section. The dependence of life on the influence of the surrounding world. Of the factors may be mentioned: (1) The *temperature* limits of plant life, and in a later section the same in reference to animal life. (2) Influence of light on plant life. (3) Surrounding media, soil, atmosphere, water, etc.

A section is devoted to the relations of plants to each other, and also to animals, or what we usually understand as ecology. The author employs this and several other terms in designating phases of these relations, going into what seems to the reviewer unnecessary details for an elementary treatise.

The second section is devoted to the "structure and vital activities of the organic world." Under this head are presented some of the more profound and difficult problems of his subject, yet on the whole the treatment is clear and stimulating, though rather difficult for pupils of the age of those concerned.

The third section deals with man as an object of scientific consideration. Brief reference has already been made to phases of this section. In general it deals with the structure and functions of the human body, problems of nutrition, metabolism, etc.

On the whole the book is worthy of cordial approval. It is well printed on good paper, and is marred by very few typographical errors.

CHAS. W. HARGITT

SYRACUSE UNIVERSITY

Elements of Physiology. By THEODORE HOUGH and WILLIAM T. SEDGWICK. Boston, Ginn & Co.

The present book is a reprint of the physiological portion of our larger work entitled "The Human Mechanism," together with chapter XX., . . . which has been added to meet the requirements of law in some states with regard to the teaching of physiology. (From the preface.)

It fell to the lot of the present writer to review the "larger work" referred to above in the issue of SCIENCE for April 19 of the current year. And since the present book is, as stated above, a reprint of the former, it will

only be necessary to briefly refer to a very few points not specially noted in the former.

As the title suggests, the book comprises the *elements of physiology*, and this it really is. Few text-books now available for use in the schools under the title of physiology are such in fact. Most are more or less cumbered with anatomy, hygiene, etc., and the physiology is thus confused with other matter. Without here considering the relative merits or demerits of these points, it is worth while emphasizing the fact that in this we have a book of essentially pure physiology, based on adequate and well-established facts. In its size and the scope of its matter it comes well within the time usually given to the subject in the average school. In its mechanical features the book is worthy of all praise. C. W. H.

Practical Physiological Chemistry. By PHILIP B. HAWK, M.S., Ph.D. 416 pages, illustrated. Philadelphia, P. Blakiston's Son & Co. 1907. Price, \$4.00.

The appearance of another work on physiological chemistry is a further evidence of the rapid growth of this department of science in our American universities, and a proof, also, that something more than the old, so-called "medical chemistry" is beginning to find favor in our schools of medicine. This book by Dr. Hawk is written for students of medicine and general science, who have already secured a good groundwork in the more fundamental branches of chemistry, and presents a very good outline of those facts of physiological chemistry which may be clearly demonstrated in a laboratory course. While the title might be taken to indicate that the work is a laboratory manual only this is by no means the case, as many of the discussions are full enough to constitute a general treatise on the subject.

In an experimental way the book presents not only the usual general tests and qualitative reactions, but also a very considerable number of quantitative methods applicable in physiological-chemical investigations. Most of these are clearly described, and are full enough for working conditions, but in a few

cases the value to the student would be greatly increased by the addition of fuller explanations. For example, in describing the determination of total and inorganic sulphates in the urine practically nothing is said concerning the reasons for the several steps, and at first sight the student is very likely to fail to recognize the real distinction between the two processes. A number of similar cases have been noticed.

The mechanical work on the book is most excellent. It is printed from clear type on good paper, and is bound in such a manner that it remains flat when opened on a table, a good quality not very often found in books intended for the laboratory. J. H. LONG

Elements of Physical Chemistry. By HARRY C. JONES. Third Edition. 8vo. Pp. 650. New York, The Macmillan Company. 1907.

This text-book is so well known that the appearance of a new edition calls for only a brief statement in regard to the changes that have been made in it.

The revised edition follows very closely the plan of the first, but it has been somewhat enlarged by the addition of matter pertaining to recent advances in the science. The chief additions deal with Thomson's work on electrons, Morse's work on osmotic pressure, recent work on radioactivity, and there are about twenty pages devoted to the author's hydrate theory and his work on conductivity in mixed solutions. There are many minor changes, and some of the rather complicated cases of equilibrium discussed in the first edition have been wisely omitted. Many references to the original literature have been added, which make the book a valuable one for reference.

H. W. FOOTE

Outlines of Psychology. By WILHELM WUNDT. Translated by C. H. JUDD, Ph.D. Third English from the seventh revised German edition. Leipzig, Wm. Englemann. Pp. xxiii + 392.

The third edition of the English translation of Wundt's "Outlines" brings the work to the English-speaking student as it appears in

the seventh and doubtless the definitive German edition. For those who have not been able to keep in touch with the rapid succession of German editions, it may be interesting to note that both in form and matter the new edition holds closely to the first. As compared with the second English edition, the present shows only two additions to the table of contents; and one of these merely emphasizes a division of the text already in existence. Thus those familiar with the earlier editions will find the relation between chapters, paragraphs and their subdivisions unchanged. Moreover, in the glossary of technical terms there is no change save that occasioned by the changes in German orthography and the substitution of *K* for the initial *C* in the words "Komplikation" and "Kontrast."

The most conspicuous change in plan between the second and the third English editions is the introduction of some twenty odd figures and diagrams. They must be distinctly helpful to the student. As one might expect, they are wonderfully simple and effective. To the present reviewer at least they seem to lose something of their force by retaining the German words that occur within the figure. The translation below seems hardly to balance the possibility of initial discouragement by the unfamiliar designations.

In the text itself, in spite of the general similarity of arrangement and terminology, there are many minor changes and some marked ones. Most of these changes are simple revisions of the English phrase, or changes occasioned by some modification of the German phrase. Many of them consist of additional matter relating to the new cuts and figures. Some few of them, as for example the modification of the statement of the correlation between feeling and pulse (pp. 96-97), are concessions to criticism or indicate minor changes of attitude on the part of the author. Such changes, however, are rare.

English-speaking students are fortunate in possessing such a scholarly translation of the great psychologist's answer to the average student's needs.

RAYMOND DODGE

WESLEYAN UNIVERSITY

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

THE first regular meeting of the session of 1907-08 was held at the Chemists' Club, 108 West 55th Street, on October 11.

Dr. Hugo Schweitzer read an obituary of the late Durand Woodman, who has always taken an active interest in the work of the section. He was secretary and treasurer for several years and was a member of the executive committee when he died.

Mr. C. B. Zabriskie was elected to succeed Dr. Woodman on the executive committee.

The following papers were read:

Report on Toronto Meeting: M. T. BOGERT.

Some Transmutations of the Past Century: CHAS. BASKERVILLE.

Ignition Temperature of Gaseous Mixtures (Second Paper): K. G. FALK.

Discussion of Dr. Falk's Results with Reference to their Bearing upon Gas Engine Problems: C. E. LUCKE.

C. M. JOYCE,
Secretary.

THE AMERICAN PHILOSOPHICAL SOCIETY

At the stated meeting held on October 18, the following paper was read:

The Growth of the Albino Rat as compared with the Growth of Man (with lantern illustrations): Professor HENRY H. DONALDSON.

SPECIAL ARTICLES

HEREDITY OF EYE-COLOR IN MAN

It has been known that eye-color in man is inherited as an alternative character. Alternative inheritance is usually associated with Mendelism. Is human eye-color inherited in Mendelian fashion? The importance of knowing whether it is depends on the fact that, if Mendelian, the result of any combination of eye-colors of the parents upon the eye-color of the offspring can be, within certain limits, predicted.

The data on which this study has been made were collected with the assistance of school

principals and other friends. The records were made on blanks calling for the eye-color through three generations. The total number of cards—each giving the ancestry of one individual—is 132, of which 57 are single cards to a family while the remaining 75 are distributed in 20 families, an average of $3\frac{3}{4}$ children to a family.

Human eye-color falls into the main classes, blue and brown. The blue color of the iris is what is known as a structural color; no blue pigment is present, but there is a small quantity of scattered granules, reflection of the light from which gives a blue color exactly as reflection from suspended particles makes the air blue. The black pigment of the choroid coat gives a background that favors the reflection of light and prevents transmission; in albinos, who have no black choroid coat at the retina, light is reflected from the back of the eye and the iris appears reddish by transmitted light even as the sky is red at sunset. Brown eyes, on the contrary, contain melanic pigment, reflection from which yields black. Thus the blue eye is the absence of pigment. In addition to the two fundamental types we have black eyes, due to a greater quantity of pigment, and light (*i. e.*, dilute) brown eyes. In addition to black pigment the iris frequently contains more or less yellow in specks or patches. This is doubtless a fat-pigment or lipochrome. The combination of black and yellow pigment gives a green color as it does in the green canary, and such green and blue eyes are commonly called "gray." But "gray" is also used for blue eyes with some brown pigment in larger or smaller patches.

The nomenclature of eye-color which collaborators were requested to employ was as follows: Light blue, dark blue, blue-green or gray, hazel or dark gray, light brown, brown, dark brown, very dark brown or black. This nomenclature was generally followed and seemed to be understood except in the case of "hazel," which we suspect was employed in certain dark bluish-grays. The classification was probably too detailed and the three groups of blue, gray and brown would doubtless have sufficed. In the following summaries minor

divisions of these three fundamental groups will frequently be neglected.

The first result which an analysis of the pedigree data reveals is that blue eye-color is recessive to brown. The first evidence of recessiveness is the purity of the germ cells of the recessive type, so that when two recessive individuals are mated *inter se* they throw only the recessive type. Of the offspring of two blue parents 69 are blue and 6 blue-gray or gray. Two additional cases of so-called "hazel" eyes we suspect to be of a blue type. Again, whenever in one family, both father and mother have blue eyes, all children have blue eyes. This is true in the Ge. and Sw. families of three children each, the Hur. family of 4 children and the Re. family of 6 children.

The second criterion of recessiveness is the absence of offspring of the recessive type from parents one of which is of the recessive type and the other a homozygous dominant. The only family that seems to meet the conditions of having a homozygous dominant brown parent is a small one (Sa.) as follows:

Children	Parents	Grandparents
Boy, dark brown	{ light brown blue	{ brown brown
Girl, dark brown		{ blue light blue

A third criterion is found in crosses of the $R \times DR$ type where a recessive is mated with a heterozygous dominant; in this case there should be an equal number of offspring of each type. Six matings of this sort give 16 dark-eyed to 9 light-eyed offspring—a deficiency of the light-eyed group which is probably due to the small numbers.

Since blue or absence of pigment is recessive we should expect to find some cases of two homogametous dominant browns which produce only brown-eyed offspring. We apparently have one such family (McB.) in which the four grandparents, two parents and five children have all dark brown eyes. The behavior of brown alone thus confirms that of browns when crossed with blues, and all results prove that black iris pigment is dominant over its absence.

Reference Letters	Children	Mother Father	Nature of Mating	Mother's Mother Father's Mother	Mother's Father Father's Father
Al.	1 Gray	Gray Blue	D × R	Br (gray ?) Gray (blue ?)	Gray Blue
Be.	5 Blue	Blue Blue	R × R	Dk Br (Blue ?) Blue	Blue —
Br.	1 Blue 4 Gray	Gray (blue ?) Blue	DR × R	Gray Gray (blue ?)	Dk Br (blue ?) Blue
Bu.	1 Gray	Blue Gray (blue)	R × DR	Gray (blue ?) Blk (gray ?)	Dk Br (blue ?) Blue
Do.	4 Br	Blue Dk Br (blue)	R × DR	Blue Dr Br	Blue Blue
Ge.	3 Blue	Blue Blue	R × R	Blue Blue	Gray (blue ?) Blue
He.	1 Gray	Blue Gray	R × D	Blue "Blue"	Blue "Blue"
Huf.	3 Blue	Blue Blue	R × R	Blue Blue	Blue Blue
Hur.	4 Blue	Blue Blue	R × R	Blue Br (blue ?)	Blue Gray (blue ?)
La.	3 Br 2 Blue	Br (blue) Gray (blue)	DR × DR	Blue Gray	"Gray" ?? Blue
Lu.	1 Gray	Gray (blue) "Blue-gray"	R × R	Blue Blue	Gray Blue
Ma.	1 "Blue-gray"	Blue Blue	R × R	Blue —	Blue Blue
McB.	5 Dk Br	Dk Br Dk Br	D × D	Dk Br Dk Br	Dk Br Dk Br
McC.	1 Gray	Gray (blue) Blue	DR × R	Gray Blue	Blue "Blue-gray"
Mi.	2 Blue 4 Dk Br	Blue Dk Br (blue ?)	DR × R	Gray (blue ?) Dk Br	Blue Dk Br (blue ?)
Oa.	6 Gray 2 Blue	Gray (blue ?) Blue	DR × R	Gray Blue	— Blue
Re.	6 Blue	Blue Blue	R × R	Gray (blue ?) Blue	Blue Blue
Ri.	1 Gray	Gray Br (blue)	DR × R	Br (gray ?) Br	Gray Blue
Sa ₁ .	2 Dk Br	Br Blue	D × R	Br Blue	Br Blue
Sa ₂ .	3 Br 2 Blue	Blue Br (blue)	R × DR	Blue Dk Br	Blue Blue
Sa ₃ .	2 Br 3 Blue	Br (blue) "Gray"	DR × R	Blue Gray	"Gray" ?? Blk (blue ?)
St.	1 Gray	Gray (blue) Gray	DR × R	Blue Gray	Gray Gray
Sw.	3 Blue	Blue Blue	R × R	Blue Blue	Blue Blue
Th.	1 Gray	Gray Blue	D × R	Gray Gray (blue ?)	Gray Gray (blue ?)

Reference Letters	Children	Mother Father	Nature of Mating	Mother's Mother Father's Mother	Mother's Father Father's Father
Va.	1 Gray	Gray (blue) Blue	DR \times R	Br (gray?) Blue	Violet Blue
Vo.	1 Blue 2 Gray	Blue Gray (blue?)	DR \times R	Br (blue?) Gray	Blue Br (blue?)
Wal.	1 Gray	Gray Blue	D \times R	"Blue" Blue	"Blue" Blk (blue?)
War.	1 Blue 1 Br	Dk Br (blue) Blue	DR \times R	Dk Br Blue	Blue Blue

Abbreviations: Br, brown; Dk Br, dark brown; Blk, black; D, dominant; DR, dominant and recessive (heterozygous); R, recessive.

Colors in parentheses are recessive; without a ? means observed, with a ? means hypothetical. Quotation marks means doubt if the term is used with precision. Double query, doubt as to correctness of color assigned.

It remains to consider the behavior of gray in inheritance. Upon tabulating the crosses of blue with gray we find that gray dominates over blue. This is true, for example, in the Al., Bu., He., Lu., McC., Ri., Va. and Wal. pedigrees given in the Appendix. In families where blue \times gray parents have a blue-eyed child (Br., Oa., Vo. families) the gray is doubtless heterogametous, containing recessive blue. Again, when both parents are gray-eyed they have produced 9 gray-eyed to 2 blue-eyed children—indicating that both grays are DR (containing recessive blue) expectation being three gray to one blue. Consequently, gray or partial pigmentation is dominant over the pigmentless blue and the occasional enumeration (Ma. family) of descendant of two blue-eyed parents as "blue-gray" or "gray" is due to a slight inaccuracy of classification. On the other hand, gray is recessive to brown (La. family), *i. e.*, a slight pigmentation to an extensive one.

The facts brought out by these statistics show, first, that there are two principal classes of eye-color—brown and blue: that brown varies in intensity from black to light brown; that blue or absence of pigment varies from pale to deep; that blue is frequently imperfect owing to the presence of specks or patches of pigment—the "gray" or "hazel" color; that blue is recessive to gray and gray is recessive to brown.

The practical applications of these results

to human marriage are as follows: Two blue-eyed parents will have only blue-eyed children; two gray-eyed parents will have only blue-eyed and gray-eyed but not brown- or black-eyed children; brown-eyed parents may have children with any of the colors of eyes. Gray and blue-eyed parents will tend to have either gray-eyed children only or an equal number of gray- and of blue-eyed children according as the gray-eyed parent is homozygous or heterozygous. When one parent has blue eyes and the other brown the children will be all brown-eyed, if the brown-eyed parent is homozygous—otherwise they will have eyes of various colors according to the gametic constitution of the brown-eyed parent. In case one parent has gray eyes and the other brown we may have the following cases in the offspring: all of them brown-eyed (dark parent homozygous); 50 per cent. gray and 50 per cent. brown (brown parent heterozygous in gray or blue); 25 per cent. blue, 25 per cent. gray and 50 per cent. brown (both parents containing recessive blue germ-cells).

GERTRUDE C. DAVENPORT
CHARLES B. DAVENPORT

THE NOMENCLATURE OF DEXTRAL, SINISTRAL AND ATTENTIONAL ORGANS AND FUNCTIONS

IN the *Popular Science Monthly*, August, 1904 (republished in *Biographic Clinics*, Vol. III.), I made some suggestions as to the nomenclature of the organs and functions

pertaining to right-handedness, left-handedness, etc. After a more extended study and experience of the subject I recognize that I made some errors and more omissions, and these I may now correct. The terms *right-handed* and *left-handed* are so firmly fixed in the language, and so recognized as expressing the unconscious choice and superior expertness of one or the other hand for certain tasks, that it is useless to attempt putting them aside for more accurate words. Established usage and habit make language and govern the world. "Right-handed," "left-handed," etc., imply nothing of expertness, etc., literally, but usage has put such meanings into them. Terms merely localizing the organs without added significance must therefore be devised, *e. g.*, *dextral*, *sinistral*, *dextromanual*, *dextroocular*, and all the rest. To extend the idea of expertness to the corresponding organs, *right-eyed*, *left-eyed*, *right-footed*, *right-eared*, etc., may be used after the analogy of *right-handed*. The words *ambidextral* and *ambidexterity* should never be used by sensible persons. No one has yet existed with two dextral hands; no left-handed person has ever been trained to have an equal proficiency or expertness of each hand for all tasks; it would be most undesirable and wasteful of life to have such equal expertness; all or most such attempted training results in unhappiness, confusion, inexpertness and disease; the right-handed, according to the crazy theory, should be trained to an equal and ludicrous sinistromanual expertness, etc. The violinist should bow or finger equally expertly with each hand; the pianist play upon a reversed keyboard, the base notes to the right, half the time; soldiers should carry their guns and swords half the time in the left hand, step-off with the right foot first on alternate days; and all sewing, writing, use of the knife and fork, handshaking, etc., done alternately with the sinistral and the dextral hands, etc.

As to right-eyedness, left-eyedness, etc., there is a world of new facts coming to light of profound importance, medically, surgically, socially, and especially to the person abnormal in these respects. In practical ophthalmology,

"dominance" of the dextral eye in the right-handed, and the preservation of it, or reestablishment of it when lost (*vice versa* in the case of the left-handed), is of vast import, possibly to the life of many individuals. With divided or alternate dominance one of my patients was constantly making mistakes, confused, running into objects, steering his automobile into collisions, etc. (The tests are many and easily made: For instance, looking through the held-up pencil or finger at the opposite wall, an image, one image, of the pencil is seen by the dominant eye—the dextral, of course, normally, in the right-handed, the sinistral in the left-handed. If the dextral is the dominant eye, then by putting something over the left, the image will not be displaced; if the dextral eye is shut off, the image of the pencil will "jump" to the right. If the sinistral is the dominant eye, the reverse will take place.) If two images are seen, then the person has divided dominance or equidominance, and he is a patient, having confusions of mind and action which may cause accidents at any time, and which must decidedly abnormalize him in many ways. Probably equidominance is a half-way stage of the change from normal to reversed dominance. It would be better that the right-handed should have the sinistral eye dominant (*vice versa* in the left-handed) than that he should have equidominance. I have had four patients reaching middle adult life who used one hyperopic eye solely for distance-vision (*i. e.*, for objects over about two feet away), and the other myopic eye solely for all vision in reading, writing, etc. Of course the hyperopic eye in such cases (as in one of my patients), although the left (in a right-handed person), must become the dominant eye, because dominance has existence and use only in distance-seeing.

The necessity for new terms to designate the states and functions of attention comes to view in the fact that civilization is creating a new sort of consciousness and attention. The old psychology considered that attention or consciousness was to be likened to the passing of single grains of sand through the constriction of the hour-glass. That view was

largely true, because I believe that attention is genetically and chiefly a product of vision, and that vision of the older and simpler type of eye and mind was indeed that of a continuous linear stream of single images (objects) focused one after another at the macula. But the modern mind (of the great and rapid reader, of the musician, and of men in many trades and callings) is learning to see and know and use many synchronous and coordinated images, and streams of images, both at and away from the macula. There is a growth and extension of the macular region and of its imaging, one may say, or the power of attention and consciousness is growing more and more able to receive, interpret and control the many streams (which is the same thing as the enlarged stream of sand grains), of images focused in and about the macula. Thus mental largeness, power, attention and consciousness are growing at a great rate in our complex and differentiating civilization, and the old nomenclature based upon the hour-glass comparison is no longer adequate. Especially if is added the marvelous power of the ear, as in the musician, to receive, encompass and be conscious of ten, fifty or even a hundred streams of discrete synchronous tones. The following terms may therefore be found useful:

Right-handed.—Preferring the dextral hand for the more expert or intellectual tasks. Whence *right-handedness*.

Left-handed.—Preferring the sinistral hand for the same tasks. Whence *left-handedness*.

Right-eyed.—Preferring the dextral eye as the dominant one.

Left-eyed.—Preferring the sinistral eye as the dominant one.

Right-eared.—Preferring the dextral ear as the one with which to hear sounds.

Left-eared.—Preferring the sinistral ear with which to hear.

Right-footed.—Choosing the dextral foot as the one to guide and base action, from which to spring in beginning to march, in spading, etc. "Step off with the left foot forward."

Left-footed.—The power is furnished and governed by the sinistral foot.

Right.—Moral, good, etc.

Sinister.—Unlucky, gloomy, etc.

Dexterity.—Expertness, agility, etc.

Dextrous.—Expert, agile, etc.

Because of popular usage, the four preceding may retain their vague significance in common speech, but not in science.

Dextral.—Pertaining to the organs on the right side of the body, regardless of expertness, preference, etc. When facing east the dextral hand is on the south side, the sinistral on the north side.

Sinistral.—Pertaining to the organs on the left side of the body, regardless of special preference, expertness, etc.

Dextrality, Sinistrality.—The corresponding abstract qualities, regardless of expertness, etc.

Dextrad, Sinistrad.—Toward the dextral or sinistral side of the body, respectively.

Dextromanual, Sinistromanual.—Pertaining, respectively, to the dextral or to the sinistral hand without regard to expertness, etc.

Dextrocular, Sinistrocular.—Pertaining to the eye on the dextral side, or the sinistral side, respectively, regardless of expertness, etc.

Dextropedal, Sinistropedal.—Pertaining to the feet, in the same way.

Dextraural, Sinistraural.—Pertaining to the ears, in the same way.

Dextrocerebral, Sinistrocerebral.—Located in the right, or the left, cerebral hemisphere, respectively.

Ambidextral, Ambidexterity.—Words without significance, or existence in fact, "ghost-words," which should never be used.

Dominant Eye.—The eye which is unconsciously and preferentially chosen to guide decision and action.

Divided Dominance, or Equidominant Eyes.—With shared or equal dominance.

Alternating Dominance of the Eyes.—Dominance of one eye at one time or for one function, alternating with that of the fellow for another time or function.

Reversed Dominance.—The left, because of ametropia, disease, operation, etc., of the right, becoming the dominant eye in the right-handed; or *vice versa* in the case of the left-handed.

Dextroexpertness.—Conjoint and superior

expertness of the dextral sensory and muscular organs of the body; the union of right-handedness, right-eyedness, right-earedness and right-footedness. The innervational centers of the more expert organs are located in the left side of the brain.

Sinistroexpertness.—Conjoint and superior expertness of the sinistral sensory and muscular organs of the body; the union of left-handedness, left-eyedness, left-earedness, and left-footedness. The innervational centers of the more expert organs are located in the right half-brain.

Mixed Dextrosinistral Expertness.—Some of the centers of the more expert organs in conjoint action are located in one, and some in the opposite half-brain. What was once meant by the really meaningless term "ambidexterity," as applied only to the hands.

Trailing Hand, "The Trailer."—In synchronous writing of both hands, that upon which the attention, visual or central, is not fixed.

Visual Attention.—That existing when the eyes consciously observe a fixed or moving object; during the act central or mental attention is fused with it.

Central Attention.—The "imagination," or mental remaking, of the image, by the mind or central mechanism when the peripheral visual attention is abrogated.

Single-stream Visual Attention.—That form of visual attention existing when the eyes follow a linear concatenation of single or unitary macular images to the exclusion of all others.

Single-stream Central Visual Attention.—That when the central visual attention, without objectively forming images, follows the passing of imagined single or unitary images in single file.

Multiple Synchronous Visual Attention.—That when the attention recognizes two or more discrete sets of retinal images at the same time—as when the musician reads several staves of music-notes, observes key-boards and pedals, the indications as to stops, tempo, expression, etc.

Multiple Synchronous Central Visual Attention.—The imagining or mental reproduc-

tion of multiple synchronous visual trains without the objectively formed images.

Single-stream Auditory Attention.—That when a monotone, a sound, or concatenation of single notes or sounds, is listened to, exclusive of others.

Single-stream Central Auditory Attention.—That without the objective audition.

Multiple Synchronous Auditory Attention.—Two or more synchronous tones or sounds, or lines of such tones or sounds, are recognized by consciousness, as in the case of the orchestra-leader who gives attention to a large number.

Compound Synchronous Attention.—In this the consciousness recognizes and correlates or combines multiple streams of synchronous and diverse stimuli, visual, auditory, etc. Illustrated by expert telegraphers, locomotive engineers, musicians, etc., seeing, hearing and feeling consciously at one instant.

GEORGE M. GOULD

COLOR VARIETIES OF LOCUSTIDÆ

IN SCIENCE for August 16, 1907, Mr. A. Franklin Shull publishes some notes on a pink form of *Amblycorypha oblongifolia* and calls attention to the rarity of records and data relating to such specimens. Mr. Shull's communication touches upon a most interesting subject that has been but little investigated, namely, the direct influence of food upon the coloration of certain phytophagous insects. The following remarks may stimulate some investigator to take up this neglected subject.

A live specimen of the pink form of *Amblycorypha oblongifolia* was recently presented to the National Museum by Dr. J. N. Rose, who captured it at the New York Botanical Garden on August 15, 1907. This specimen is perhaps the most richly colored one that has come to notice and it was captured in surroundings that suggest a derivation of this unusual coloration from food. The following descriptive notes were made from the living insect. The color is a deep rose, which could almost be called a crimson; it shows a delicate but distinct violet tinge. This violet

cast is most pronounced upon the more delicately colored soft parts—the mesothorax, metathorax and abdomen. This coloration hardly agrees with that of the two specimens described by Scudder, the female as “pale coral-red verging on magenta” and the male as “orange red.” The present specimen is a female and the green color of the common form is replaced by red throughout. There are only a few dark brown markings: on the pronotum the lateral carinae are heavily marked with deep brown and the tegmina have a patch of the same color on the apical portion of the dorsal field; at the sides the tegmina show three rows of more or less confluent brown spots, the upper row longest and heaviest. There are many indistinct whitish maculations on the sides of the prothorax and particularly dense upon the cheeks and the face. The ocelli are opaque white. The eyes are light gray, creamy white along the inner margin and in the middle, with irregular dark blotches suffused with red. The tegmina show many indistinct creamy maculations. The corneous portion of the wings, which projects beyond the tegmina, is red, the membranous portion hyaline with the network of veins rose-red. The ovipositor is brown at the tip. The legs are a slightly fuller crimson than the body, the tibiae and tarsi deeper colored than the femora. The hind tibiae are a very dark crimson-brown.

It should be noted that brown specimens of Locustids occur occasionally and in some of these there is a trace of pink, as it were, showing through the brown. Some years ago the writer took a specimen of *Amblycorypha oblongifolia*, near Springfield, Mass., of a pale brown color suffused with pink. There is a similar specimen in the National Museum collection, taken at Dorsey, Md., August 20, 1904, by Miss R. Jones. It is such a specimen that Mr. Shull describes in his article.

It is a well-known fact that color variations of the same character occur in many green lepidopterous larvæ. Caterpillars showing these variations in color may be found upon the same food plant under the same conditions; these colors apparently do not depend

upon any particular environment, but are directly due to the insect's food. Incidentally they are protective in most cases. Poulton in his statement “that some of the colors of certain Lepidopterous larvæ are made up of modified chlorophyll derived from the food-plant” refers to this green or brown general body-color.¹ Through experiment he reached the conclusion that “etioline, no less than chlorophyll, can be transformed into a larval coloring matter, which may be either green or brown, and is so disposed as to form a ground color.”² It should be added that the processes which produce the change from green to brown or red in chlorophyll are understood to be of a very subtle nature. The colors of the Locustidæ are in all probability of the same origin. These insects are almost wholly phytophagous and their coloration strongly resembles in character that of the lepidopterous larvæ in question. In both cases, through the rapid assimilation of food, the plant juices are taken into the organism practically unaltered. With the Lepidoptera these colors are eliminated during the pupal period; in the Locustidæ, which reach maturity by a series of molts and continue feeding in all stages, the colors persist to the adult insect. Scudder has already pointed out that season or temperature are hardly admissible as agents in these color variations.³ The pink or brown specimens appear at the same season with the green ones and they occur among the Locustidæ of the tropics as well as with those of temperate regions. Dr. Rose has called my attention to the fact that at the New York Botanical Garden, where the above-described red specimen was taken, there is an abundance of crimson foliage. It is, therefore, not improbable that in this specimen the crimson color is due to a coloring matter contained in the foliage upon which the insect fed.

Two methods of investigating these colors of the Locustidæ may be suggested: One is by comparative spectroscopic tests of the coloring matter of the insects and plants, the other is

¹ *Proc. Roy. Soc. London*, Vol. 54, p. 41, 1893.

² *L. c.*, p. 426.

³ *Entomological News*, Vol. 12, p. 131, 1901.

by rearings of the insects in separate lots, fed upon green and red foliage respectively.

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CONE IN CONE

SIMILAR limestones of same geological age are seen high in the Missouri bluffs from the Platte and Buchanan County line to the Andrew County line. Beyond the Nodaway River we find these beds lower in the hills and within two miles are seen near the railroad grade.

These limestones are No. 150 and 152 of my section of the Upper Coal Measures, published in the Missouri Geological Report entitled "Iron Ores and Coal Fields," 1872, in part 2, page 92.

No. 150 occurs in strata of irregular thickness. Near Amazonia certain beds of it have been reported to make a good quality of hydraulic cement. Twenty feet is the total thickness of No. 150.

No. 152 lies above and is separated from 150 by two feet of clay shales. No. 152 is sometimes oolitic and also shows cross lamination. It furnishes an excellent building stone. Lander's quarry, a few miles north of Savannah, Andrew County, is of this rock. Overlying No. 152 we sometimes find a two-inch bed of cone in cone.

At only one other horizon in Missouri has cone in cone been obtained. It is found at Henry Kunkel's, on Nichols Creek, in Holt County, occupying a position approximately 175 feet above the other I have mentioned. Very fine specimens have been obtained from Nichols Creek, where it is about three inches thick.

The finest specimens of cone in cone I obtained from a branch of Dry Fork, in the northwest part of Bond County, Illinois, near James Valentine's and probably in Sec. 19 T. C. N. R. 4 W. Pocahontas is probably the nearest town. We found here twenty feet of argillaceous shale beds with flattened iron-stone concretions resting on three feet of gray fossil-bearing limestones. The cone in cone

occurs twenty feet above the limestone and is about two and a half inches thick. In composition it is an argillaceous limestone and shows perfect cones interlocking from each surface. It was traced along the branch for several hundred yards. [See Vol. VI., Ill. Geol. Surv., p. 133.]

In Geological Survey of Wisconsin, Iowa and Minnesota D. D. Owen, Phila., 1852, p. 112, mention is made of "Tutenmergel" being found in Iowa near certain briny springs. He states that in Germany its origin is thought to be from shrinkage of strata. But Owen speaks of it in Iowa and refers it to the imperfect crystallization produced by mineral matter filtering through marly beds. Dr. B. F. Shumard, who was much with Owen, informed me that Owen's tutenmergel was cone in cone. I think the former probably due to imperfect crystallization under pressure. Its origin and that of arragonite may be the same. Von Cotta speaks of it as "Tuten-nagel."

Stylolite structure, so common in many of our Lower Carboniferous limestones, may have a similar origin, but the cone is wanting.

G. C. BROADHEAD

COLUMBIA, Mo.,
July, 1907

QUOTATIONS

EXTERNALISM IN AMERICAN UNIVERSITIES

It is but natural, where organization is so important and the office of administration is magnified, that the presidency should fast lose its connection with active and advancing scholarship. There is so much governing to be done—because in our universities we trust so much to government—that in but few places can a president continue a scholar's life. So the old type of leader, learned and temperate, fast yields to the new type,—self-confident, incisive, Rooseveltian. And with the coming of the new type, there seems to be an increasing stress upon rapid accomplishment, upon "doing things," with grave risk that our places of learning will preserve a less clear vision of what is catholic and enduring.

The constitution of our universities is an

appearance of their indwelling mind, and therefore is of moment for their future. It is difficult to foretell whether the American will continue forever the government that was well enough for a boys' academy in colonial times. The desire is unquestionably awakened in us to have universities that can stand with the greatest of the world; and the desire will in the end, I believe, lead us more and more to distrust external rule. Our present forms have served our nonage; the days of our ignorance have been winked at, but now we are commanded everywhere to repent. We shall hardly reproduce in haste the European models, with all their clear advertisement that they are scholars' commonwealths, are municipalities of science; and yet it can not be thought that we shall continue forever and without regret upon our present course. We shall in the end place less reliance upon commercial methods in discovering and bringing into harmony the choicest minds; the university will perceive that it must become for them a hospitable place, showing in its very laws and customs that it is a union of gifted persons sanely working together to increase the store of intelligence among men. It will feel that it must bestow on all who come within its walls the keys and freedom of a great city.—Professor George M. Stratton in the *Atlantic Monthly* for October.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

BRITISH RAINFALL

THE forty-sixth annual volume of that unique publication, *British Rainfall* (1906), is at hand. Dr. H. R. Mill informs us, much to our regret, in his preface, that "the stationary condition of the available funds" has made it necessary for the editor to "divert a considerable part of his time from editorial duties to remunerative work." It is a great pity that the British Rainfall Organization, which is of such immense importance to the people of the British Isles, should suffer for lack of support. In this connection we note that His Majesty the King heads the subscription list. Dr. Mill points out that by means

of an automobile, kindly placed at his disposal by one of his regular observers, he was able to make inspections of several rainfall stations in a very much shorter time than would have been taken up had he traveled in any other way. The present volume of *British Rainfall* contains a discussion, by L. C. W. Bonacina, of "The Effects of Exposure to Wind upon the Amount of Rain caught by Rain Gauges, and the Methods of Protecting Rain Gauges from them," with a bibliography. We desire once more to call attention to Dr. Mill's study of "Heavy Falls on Rainfall Days in 1906," in which the cyclonic control of special rainfalls is discussed and illustrated. It would be well if for every state in the American union we had such studies each year.

LIGHT AND BACTERIA

DR. JOHN WEINZIRL has recently investigated anew "The Action of Sunlight upon Bacteria, with Special Reference to *Bacillus Tuberculosis*" (*Bull. Univ. New Mex., biol. ser.*, III., No. 12, 1907). The results obtained by previous investigators were, in the opinion of the writer of this paper, markedly and unfavorably affected by reason of the investigators' methods of exposing the organisms to sunlight, exposure under glass necessitating reflection and absorption of a large proportion of the sun's rays. By improved methods Dr. Weinzirl believes that he has come much nearer the truth. He finds the effect of sunlight much more powerful than previous results indicated. From two to ten minutes of direct exposure to sunlight is sufficient to kill the bacteria. This gives added emphasis to the advantage of a dry climate, like that of the western United States, where dryness and sunshine quickly destroy most bacteria. The importance of well lighted and ventilated houses is also emphasized. "The results by direct exposure of the bacteria indicate that sunlight is a much more powerful germicidal agent, and consequently a more important hygienic factor, than it has heretofore been considered; that the bacteria, when freely exposed, are killed in one fifth to one twentieth of the time formerly considered necessary."

PHENOMENAL RAINFALL IN SUVA, FIJI

The Quarterly Journal of the Royal Meteorological Society for July, 1907, contains a discussion of a phenomenal rainfall in Suva, Fiji, August 8, 1906, which came during a thunderstorm. Unfortunately, the exact amount had to be, in part, estimated, owing to the observer's having failed to measure the fall at intervals during the night. The measurements showed a fall of over 37 inches, without taking into account the overflow, which was an unknown quantity. The gauge was twenty-five feet above the ground, and the observer calculates that the total fall must have been fully 41 inches in about 13 hours. Considerable uncertainty naturally attaches to this record, but there can be no doubt that the rainfall was a very heavy one.

RAINFALL IN THE LAKE REGION

A STUDY of the average annual precipitation in the Lake region, by Professor Alfred J. Henry, of the United States Weather Bureau, appears in the *Meteorological Chart of the Great Lakes*, No. 1, 1907, and is illustrated by a chart. Measurements of rain and snow have now been made for a period of thirty-six years (1871-1906) at 21 stations. The period 1871-1906 is taken as the fundamental period. The total number of stations used was 107, all but 7 of which had more than ten years' observations. The records of ten years and over were generally reduced to the fundamental period. The total annual amount of rain and melted snow is about 31 inches. The increase in precipitation due to the presence of the Great Lakes is probably not more than 2 or 3 inches annually.

VARIATIONS IN LEVEL OF LAKE CHAD

The Scottish Geographical Magazine, August, 1907, summarizes the results of military reconnaissances undertaken in 1906 by the troops in the Lake Chad region, including notes obtained from the natives in regard to the changes of level of Lake Chad. There seems to be a twenty-year periodicity, and at the end of four or five twenty-year periods there seems to come an almost complete desiccation, and then a great rise of level. An old

native remembered a drying up which has been placed between 1828 and 1833, while in 1851, about twenty years later, the level was high. In 1906 the lake appears to have been very low.

ROUMANIAN METEOROLOGICAL WORK

A RECENT mail has brought renewed evidence of the excellent work which the Meteorological Institute of Roumania is carrying on. As lately reported in *SCIENCE*, M. Stefan C. Hepites has retired from the directorship, and has been succeeded by M. I. St. Murat. Vol. XVIII. of the *Analele* of the institute is a publication of nearly 1,000 pages, 4to, containing, in French and Roumanian, the 17th report of the work of the institute (for 1905-06); a study of the climatology of Craiova; memoirs on rainfall, earthquakes and sunshine, and the usual climatological tables. Separate brief reports concerning the hydro-metric and agricultural conditions of January-May, 1907, in Roumania, throw further light on the activities of the Meteorological Institute.

BRIGHT SUNSHINE IN THE BRITISH ISLES

"THE Distribution of Bright Sunshine over the British Isles" is discussed by Richard H. Curtis in *Symons's Meteorological Magazine* for September, 1907, and is accompanied by a chart showing the average annual duration of sunshine. The records used in the preparation of this chart are those of the burning recorders. A few records exceed twenty-five years, and series for shorter periods are available for a large number of stations. The short series have been weighted for the length of period they cover. The number of hours of bright sunshine is indicated by "isohels." In 1891 the London Meteorological Office published Dr. R. H. Scott's "Ten Years' Sunshine in the British Isles." Dr. H. N. Dickson drew the first sunshine map for the British Isles from the data in that paper (*Scot. Geogr. Mag.*, 1893). The *Atlas of Meteorology* (pl. 18) reproduces Dr. Dickson's map.

SYMONS'S METEOROLOGICAL MAGAZINE

THE five-hundredth number of *Symons's Meteorological Magazine* is that for Septem-

ber, 1907. The first number was dated February, 1866, and was published by the late Mr. G. J. Symons. Meteorologists the world over will unite in congratulating Dr. H. R. Mill upon the appearance of No. 500 of this unique magazine, and in wishing him continued success in carrying on his important work for British meteorology.

R. DEC. WARD

HARVARD UNIVERSITY

*THE NEW PHILIPPINE MEDICAL SCHOOL
ESTABLISHED BY THE GOVERNMENT
OF THE PHILIPPINE ISLANDS*

THE second annual meeting of the Philippine Islands Medical Association was held in Manila during the early months of 1905, and in the course of the discussions the fact was brought out that the Philippine archipelago has an average of only one physician to every 21,209 of the population, or one to every 430 square miles of territory. The association consequently deemed it its duty to bring this matter forcibly to the attention of the government and to request that some action be taken looking towards the establishment of a permanent and modern medical school in the Philippine Islands. The conditions for the success of such a school were very auspicious, as the Bureau of Science and the Bureau of Health would be able to furnish a number of trained men to take part in the teaching.

As a result of this agitation and also as an expression of an ideal which for some time had been in the minds of the secretary of the interior and of the various directors and members of the large scientific institutions in the Philippines, the United States Philippine Commission on December 1, 1905, passed an act establishing a medical school in the Philippine islands, placing it in charge of a board of control which consists of the secretary of public instruction, the secretary of the interior, one other member of the Philippine Commission and a member to be designated by the governor-general. The dean of the faculty of the school after its establishment also became a member of the board of control. The school is to form a department of the future Philippine University.

The actual work of organization was not undertaken until more than a year after this, one reason for the delay being that other scientific undertakings were in the course of active growth, and the other because much time was necessary to perfect the actual working plans. However, a faculty was finally appointed, including the chairs of chemistry, clinical medicine, tropical medicine, surgery, hygiene, pathology and bacteriology, pediatrics and obstetrics, with associate professors in several of the branches and with assistant professors in charge of anatomy, pharmacology, and physiology. The full professorships of the latter three chairs were left open because it was realized that the three assistants would need to be called from the United States, and it was desired to leave the higher positions open so as to give more opportunity for advancement to the right men. About one third of the faculty consists of natives of the islands, the other two thirds being either government employees or American physicians or surgeons engaged in hospital practise in Manila.

The most serious subjects to consider in planning the work for the first year were the nature of the entrance examinations to be required, the number of years of study and the feasibility of admitting students to advanced classes who were either graduates of the present medical school of the University of Santo Tomas or who had taken one or more years of medical study therein. These questions present different phases than they do in the United States, as in America there already are a sufficient number of medical schools of good standing, and no communities are actually suffering from lack of medical attendance; whereas in these islands we must endeavor to furnish reasonably well educated physicians as soon as possible, so that the duty of the faculty is not only to elevate the grade of medical instruction in the Philippine Islands, but also as rapidly as may be feasible to fit with at least a fair knowledge of medicine young men who should be able to take their places in the provinces where no medical attendance whatsoever is now possible. A

rigid standard of entrance examinations could be lived up to, provided these were so to be gauged as to provide not only for admission from the government schools conducted under American auspices and giving a grade of instruction parallel to that in the United States, but also from a number of academies and colleges under ecclesiastical control. The entrance examinations for the first year were therefore conducted so as to secure for us a very good class of students, some of them perhaps not the equal of our own high school graduates in certain branches of study, but all of them with sufficient training of one kind or another to enable them successfully to carry on their medical studies. It seemed impossible to secure students on examination for the advanced years, as our courses of study would be so different from the ones which had been conducted in the ecclesiastical medical school existing in the Philippine Islands, that it would be hopeless to expect candidates to pass the same questions as would be submitted to our own scholars; consequently, the faculty decided it to be advisable to admit to the advanced classes only special students not candidates for a degree, and to permit the latter gradually to become regular upon passing the examinations at the end of each college year.

The government approved of the above plans, and to enable the school to establish the first four years of its five years' course, it appropriated the sum of \$64,000 United States currency to meet the ordinary expenses of equipment and salaries. A temporary building was assigned to the faculty, which was fitted up to serve fairly well for two years, the laboratories being those of chemistry, anatomy, bacteriology and pathology, clinical microscopy, histology, physiology and pharmacology. In addition to this appropriation there also were provided fifty additional free beds in St. Paul's hospital, so that the number at the disposal of the school for clinical purposes in the first year will be one hundred. Rooms were also prepared for an out-of-door, free dispensary in the same hospital building. The members of the civil government who were to teach in the Philippine Medical School accepted

their positions without additional remuneration, so that the expenses for salaries were only to pay members of the faculty not otherwise engaged in government work.

As soon as the funds were available, the necessary microscopes and apparatus for a thoroughly modern equipment were ordered from abroad and the entrance examinations were held on June 10. The school began its first year with fifty-four matriculates and it must be confessed that the standard of work among the students in the first three months has been very high. The school was able to secure the services of Dr. Robert Bennett Bean in anatomy and Dr. Philip K. Gillman in pathology, but as yet has not called any incumbent to the chairs of physiology and pharmacology.

As soon as the temporary quarters were occupied and instruction was being carried on systematically, the faculty began to plan for its new medical building and for a general hospital, the staff of which should be the members of the faculty of the school. The government, realizing the necessity of these improvements has appropriated \$125,000 for the Medical School building and \$390,000 for a general hospital of 350 beds. These permanent structures insure the future of the medical school, and will in all probability be occupied within the next eighteen months.

The establishment of this medical school is one of the greatest steps recently made in the advance of the American government. The great benefits to be derived from the obstetrical ward and our out-door clinic alone would warrant the outlay, as we strongly hope soon thereby to exert a marked influence upon the alarmingly high infant mortality in the Philippines. The graduates of the school in a few years will also begin to make their presence felt. The American physician has never been able to reach the common people in the same way as the native, and the missionary work of a good number of well educated native physicians in the matter of hygiene and public health can not be underestimated.

The training and character of the members of the faculty render it certain that their

time will not only be devoted to teaching but also to the advancement of research in tropical medicine.

PAUL C. FREER,

Dean of the Philippine Medical School

SOME ASTRONOMICAL CONSEQUENCES OF THE PRESSURE OF LIGHT¹

THE experiments of Lebedew and Nichols and Hull have proved conclusively that light presses against any surface upon which it falls, and the extraordinarily accurate experiments of Nichols and Hull have fully confirmed Maxwell's calculation that the pressure per square centimeter is equal to the energy in the beam per cubic centimeter.

A clearer idea of the effect of light or radiation pressure is obtained by thinking of a beam of light as a carrier of momentum. We then see that not only does it press against a receiving surface, but also against the surface from which it started.

Some experiments by Dr. Barlow and myself appear to bring to the front this conception of light as a momentum carrier. If a beam falls on a black surface at an angle to the normal, there should be a tangential stress along the surface. An experiment was described in which light fell on a blackened disc at the end of a torsion arm, the disc being at right angles to the arm.² The disc was pushed round by the tangential stress. The experiment was carried out in a partially exhausted vessel, but the residual air was a source of disturbance by convection and radiometer effects. A better experiment was made by suspending a disc of mica blackened beneath, about two inches in diameter by a quartz fiber, the disc being horizontal and suspended from its center. When a beam of light fell at 45° on a part of the disc, the horizontal component of the beam being at right angles to the radius to the part where it fell, the disc moved round through the combined effects of convection, radiometer action and the tangential stress. When the beam was allowed to fall on the same place at 45° on the other side of the vertical, convection and radiometer action

were very nearly as before, but the tangential stress was reversed. The difference in torsion in the two cases was twice that due to the tangential stress. An experiment with prisms³ was also described.

Regarding a beam of light as a momentum carrier, it is easily seen that if the receiving surface has velocity u towards the source and the velocity of light is U , the pressure is increased by the motion by the fraction u/U . If the velocity is reversed, the pressure is decreased by this fraction. This is the "Doppler reception effect."

If the source is moving, and we assume that the amplitude of the emitted waves depends on the temperature and nature of the source alone, it can be shown that the pressure on the source is $U/(U \mp u)$ of its value when the source is at rest. This is the "Doppler emission effect."

In considering the consequence of light pressure, it is necessary to know the temperature of a body exposed to the sun's radiation. It can be shown that a small black particle, at the distance of the earth from the sun, has about the mean temperature of the earth's surface, say 300° Abs., and that the temperature of the sun is about twenty times as high, say 6000° Abs. The temperature of the particle varies inversely as the square root of its distance from the sun.

The direct pressure of sunlight is virtually a lessening of the sun's gravitation pull. On bodies of large size this is negligible. On the earth it is only about a forty-billionth of the sun's pull, but the ratio increases as the diameter decreases, and a particle one forty-billionth of the earth's diameter, and of the same density, would be pushed back as much as it is pulled in, if the law held good down to such a size. If the radiating body is diminished, the ratio of gravitation pull to light push is similarly diminished, and it can be shown that two bodies of the temperature of the earth's surface and of the earth's mean density would neither attract nor repel each other, if their diameter was about one inch. The consequence of this on a swarm of me-

¹ Abstract of an address before the Royal Institution of Great Britain.

² *Phil. Mag.*, IX. (1905), p. 169.

³ *Ibid.*, p. 404.

teorites is obvious. It is probable that this balancing of gravitation and light pressure must be taken into account in the motion of the particles supposed to constitute Saturn's rings.

When we consider the motion of a small particle round the sun, we have, first, the direct pressure lessening gravitation. If it has density equal to that of the earth and diameter one one-thousandth of an inch, the lessened pull at the distance of the earth will imply a lengthening of the year by nearly two days. Secondly, the Doppler emission effect comes into play, for the particle crowds forward on its own waves emitted in front, and draws away from those emitted behind, so that there is increase of pressure in front and a decrease behind. Thus there is a force resisting the motion. The particle will then tend to fall inwards in its orbit, and in the case considered, about 800 miles in the first year. It would probably move in a spiral into the sun, and reach it in less than 100,000 years. A particle one inch in diameter would reach the sun from the earth in less than a hundred million years.

The Doppler reception effect will not come into play in a circular orbit, but in an elliptic orbit it acts as if it were a force resisting change of distance, and therefore it tends to make an elliptic orbit even more circular.

Applying these considerations to a comet regarded as a swarm of small particles coming into our system, a sorting action will at once begin. The smaller particles will have their period of revolution lengthened out more than the larger ones, and they will tend to trail behind. The Doppler emission effect will damp down the motion, and again, more markedly with the smaller particles, and all will tend to spiral into the sun. The Doppler reception effect will tend to destroy the ellipticity of the orbit, more especially with the smaller particles, and ultimately the particles of different sizes may move in orbits so different that they may not appear to belong to the same system. In course of time they should all end in the sun. Perhaps the zodiacal light is due to the dust of long dead comets.

It appears just possible that Saturn's rings

may be cometary matter which the planet has captured, and on which these actions have been at play for so long that the orbits have become circular.

J. H. POYNTING

SCIENTIFIC APPOINTMENTS AT THE UNIVERSITY OF WISCONSIN

A NUMBER of changes have been made at Wisconsin in the several scientific departments. The board of regents have named Dr. Charles R. Bardeen, at present professor of anatomy, dean of the new college of medicine. The faculty of the new medical college includes, besides Dean Bardeen as professor of anatomy, Dr. Joseph Erlanger, professor of physiology; Dr. H. L. Russell, professor of bacteriology; Dr. M. P. Ravenel, professor of bacteriology; Dr. W. D. Frost, associate professor of bacteriology; E. G. Hastings, assistant professor of bacteriology; Dr. C. A. Fuller, instructor in bacteriology and assistant in the hygienic laboratory; Dr. Harold C. Bradley, assistant professor of physiological chemistry; Dr. J. R. Blackman, assistant in physiology; Dr. Richard Fischer, assistant professor of pharmacy; Dr. Edward Kremers, professor of pharmaceutical chemistry; Dr. Louis Kahlenberg, professor of physical chemistry; Dr. Victor Lenher, associate professor of chemistry; Dean E. A. Birge, Associate Professor W. S. Marshall, and Assistant Professor S. J. Holmes in the department of zoology; Professor R. A. Harper, Associate Professor C. E. Allen and Assistant Professor R. H. Denniston of the department of botany; and Professor B. W. Snow, Professor C. E. Mendenhall, and Assistant Professor A. H. Taylor of the department of physics.

Professor Mazyck Porcher Ravenel takes charge of the Department of Bacteriology, succeeding Dr. Harry L. Russell, who was appointed dean of the College of Agriculture, vice W. A. Henry, resigned. Dr. Ravenel has been assistant medical director of the Henry Phipps Institute for the Study of Tuberculosis in Philadelphia, and was formerly bacteriologist for the State Sanitary Live Stock Board of Pennsylvania, where he carried on research work in connection with treatment of tuberculosis and rabies.

Orville H. Ensign has been appointed to the professorship of electrical engineering, in place of D. C. Jackson, now head of the department of electrical engineering at Massachusetts Institute of Technology. Professor Ensign has been general electrical and mechanical engineer of the United States Geological Survey Reclamation Service, in charge of the work on electrical and pumping problems on the Pacific coast.

A. M. Winchell, who comes from the Montana School of Mines, is assistant professor of mineralogy and petrology. Otis A. Gage, Cornell, is the new assistant professor in the physics department, and James H. Wolton, University of Illinois, is assistant professor of chemistry. Among the lecturers secured for the coming year in various departments are W. A. Richards, chemical engineer, and Charles H. Hawes, anthropologist, of Cambridge University, England.

In the department of chemistry R. K. Brewer, W. G. Wilcox, Edward Wolesensky, C. W. Hill and Charles B. Gates have been made assistants, the latter to take the place of W. H. Doughty, resigned. James T. Bowles is sanitary chemist in the hygienic laboratory, S. K. Susiski is research assistant in agricultural chemistry, and E. V. McCollum is instructor in agricultural chemistry.

John R. Roebuck, who is a graduate of Toronto University and for the past year has been professor of physics at McGill Medical College, Toronto, has been appointed instructor in physics in place of A. L. Colton. Two other instructors appointed in this department are A. W. Smith, Haverford College, and H. C. Heil, and as assistants W. A. Tittsworth, of Rutgers College, W. F. Steve, H. J. Plagge, D. S. Dye, O. H. Gaarden, F. W. Forsythe, F. K. Brainard and L. B. Aldrich were named. Raymond Schulz was made assistant in pharmacy in place of Florence Gage, resigned, and C. C. LeFebvre is the assistant. The resignation of G. M. Reed as instructor of botany was accepted, and the following assistants in the department were named: E. G. Artzburger, J. M. Brannon, Mary A. Hickman and Hallie D. M. Jolivet. The assist-

antship made vacant through the resignation of A. B. Clawson is filled by Robert W. Hegner. The new assistant in bacteriology, in place of N. W. Wayson, resigned, is O. O. Nelson, and C. W. Smith is instructor in the department. E. L. Eaton was made instructor in astronomy in the correspondence department. In the mathematics department, George D. Berkhoff and A. L. Underhill are instructors and Bruce Bartholomew, assistant. Edward Steidtman is the new assistant in mineralogy and petrology.

In the College of Engineering the following changes have been made: Ernst Flanner is instructor in electrical engineering, vice John C. Potter, resigned, and H. B. Sanford is assistant in the same subject. W. L. Dobney is instructor in mechanical practice, and J. B. Kommers and A. H. Miller are instructors in mechanics, the latter succeeding H. F. Moore, resigned. W. C. Penn is instructor in topographical engineering, and John C. Wied in steam engineering. E. E. Parker has been made instructor in bridge engineering. Paul Sladky succeeds B. S. Anderson as assistant in machine design. Robert E. Egelhoff is instructor in mechanical drawing, and M. R. Hammar succeeds J. E. Boynton in the same work. Frank W. Warner is instructor in drawing and descriptive geometry. F. W. Lawrence is instructor in hydraulics, with W. A. Gattiker as assistant.

The changes in the College of Agriculture include the appointment of Miss Louise Jahns as instructor in soils, and J. F. Reubensaal as instructor in pasteurizing.

SCIENTIFIC NOTES AND NEWS

DR. RICHARD WETTSTEIN, Ritter von Westerheim, professor of systematic botany at Vienna, has been elected president of the Association of German Men of Science and Physicians for the meeting to be held next year at Cologne.

DR. EMIL FISCHER, professor of chemistry in the University of Berlin, gave the Faraday lecture before the London Chemical Society on October 18. On the preceding day he received the degree of doctor of science from the University of Cambridge.

AN oil portrait of Dr. John Guiteras has been hung in the position of honor in the eastern amphitheater of the medical laboratories of the University of Pennsylvania, where he was professor of pathology until his return to Havana in 1900. The painting is by Armando Menocal, of Havana.

DR. ALBERT E. LEACH, formerly of the Massachusetts Board of Health, has accepted the position of chief of the new United States Food Inspection Laboratory to be established at Denver.

THE following appointments have been made to the staff of the Rockefeller Institute for Medical Research: Dr. Hideyo Noguchi, promoted to associate in pathology; Dr. G. W. Heimrod, assistant in biological chemistry; Dr. W. A. Jacobs, fellow in biological chemistry; Mr. P. A. Kober, scholar in biological chemistry; Dr. R. V. Lamar, scholar in pathology.

PROFESSOR R. M. WENLEY, of the University of Michigan, has been appointed to the Baldwin lectureship for the year 1908-9.

DR. MAZYCK P. RAVENEL, who had just returned to Philadelphia from Berlin, where he took part in the Fourteenth International Congress of Hygiene and who has now left for Madison, to take the chair of bacteriology at the University of Wisconsin, was given a farewell dinner at the University Club on October 17.

DR. ROBERT KOCH has returned from his work at Uganda on the sleeping sickness, and was expected to arrive in Berlin about November 1.

PROFESSOR WILLIAM BATESON is about to return to Cambridge after giving a number of lectures in this country. On November 2 he will lecture at Harvard University on "Hereditry, as illustrated by Mendel's Law"; on October 30 he lectured before the New York Academy of Sciences on "The Inheritance of Color in Animals and Plants."

AT the request of the government of Mauritius, the colonial office has arranged with Major Ronald Ross, professor of tropical medicine in the University of Liverpool, to

proceed to Mauritius in order to advise the government of that colony as to the best methods of dealing with malaria.

PROFESSOR CHARLES SCHUCHERT, the curator of the geological department of Peabody Museum, Yale University, spent the greater part of the summer collecting fossils and studying the geology of New Jersey, Maryland, Virginia and western Tennessee.

DR. GEORGE B. GORDON has reached Seattle, after spending the summer in archeological explorations in Alaska for the archeological department of the University of Pennsylvania. He cabled from Nome that he had been adrift in Behring Sea for twenty days.

DR. CHARLES PEABODY, of the anthropological department of Harvard University, has returned from a four-months' archeological tour abroad. He officially represented the Peabody Museum and the Division of Anthropology at the Prehistoric Congress of France held at Autun, and at the International Reunion of Anthropologists held at Cologne.

PROFESSOR W. B. CANNON, of the Harvard Medical School, addressed the Academy of Medicine, Cleveland, O., October 11, on "Some Physiological Processes in the Region of the Pylorus."

DR. HECTOR MACKENZIE opened a discussion on the complications and sequelæ of pneumonia and the possibilities of treatment by serum or vaccine at the first meeting of the medical section of the newly-established Royal Society of Medicine, which met on October 22, at 5:30 P.M.

MR. A. HENRY, reader in forestry at Cambridge University, gave his inaugural lecture on October 15, the vice-chancellor presiding. Mr. Henry dwelt upon the causes which had retarded the scientific development of forestry in Great Britain, pointed out the necessity of reafforesting the waste lands and described the course he purposed to pursue in developing the teaching of and research in forestry in the university.

FRIENDS of the late Walter Frank Raphael Weldon, M.A., D.Sc., formerly Linacre professor of comparative anatomy at Oxford and

fellow of Merton College, have offered the university a sum of about £1,000 for the foundation of a prize, with a view to perpetuate the memory of Professor Weldon and to encourage biometric science. The prize will be called the Weldon memorial prize and will be awarded every three years. It will consist of a bronze medal and a grant of money.

THE Geographical Society of Philadelphia will hold a meeting on November 6, in memory of the late Angelo Heilprin, founder of the society. Institutions and societies with which Professor Heilprin was connected will be represented by speakers, as follows: Mr. Alba B. Johnson, president of the Geographical Society of Philadelphia; Mr. Henry G. Bryant, Geographical Society of Philadelphia; Mr. Herbert L. Bridgman, American Geographical Society and Peary Arctic Club, New York; Mr. Gilbert H. Grosvenor, National Geographic Society, Washington, D. C.; Professor Russell H. Chittenden, director of the Sheffield Scientific School, Yale University; Dr. Edward J. Nolan, Academy of Natural Sciences, Philadelphia; Dr. Edgar F. Smith, American Philosophical Society, Philadelphia; Dr. Theodore Le Boutillier, Geographical Society of Philadelphia.

A MEMORIAL meeting in honor of the late James Carroll was held by the Johns Hopkins Hospital Historical Club on October 14. Addresses were delivered by Drs. William H. Welch, Howard A. Kelly and William S. Thayer.

SIR DAVID GILL and Major P. A. MacMahon represented the Royal Society and the Royal Astronomical Society at the funeral of the late M. Maurice Loewy, director of the Observatory of Paris.

MR. ALLEN H. CURTISS, a collector and student of the plants of the southern United States and of the West Indies, died in Jacksonville, Fla., on September 1, in the sixty-third year of his age.

THE death is announced of Dr. J. Grancher, professor of the diseases of children at Paris and eminent for his work on tuberculosis among children.

DR. WILLIAM MARSHALL, associate professor of zoology at the University of Leipzig, has died at the age of sixty-two years.

THERE will be a civil service examination on November 13 to fill a number of vacancies in the position of constructing engineer, in the Forest Service, at salaries ranging from \$1,500 to \$2,000 per annum. These positions are for field service in the western part of the United States, with no permanent station, and require much travel.

THE administration building of the Mount Weather Meteorological Observatory of the Weather Bureau was destroyed by fire on October 23. The loss is said to be \$25,000, including some valuable instruments.

AN imperial edict issued on October 9 ordered the Board of Revenue and Commerce forthwith to introduce a uniform system of weights and measures throughout the Chinese empire, the standards, whose character is not stated, to be fixed within six months.

It was announced at the International Congress of Psychiatry and Neurology, held recently at Amsterdam, that arrangements had been made for an International Institute for the Study of Causes of Mental and Nervous Affections. The king of Italy has offered the use of a villa near Lugano, but the institute will later be transferred to Zurich.

DURING the academic year 1907-8 Columbia University, in cooperation with the officers of the United States Navy and the United States Coast and Geodetic Survey, offers a series of public lectures in navigation and nautical science. They are intended for yachtsmen, officers of merchant vessels in New York harbor, and all persons interested in the safe navigation of the seas. The lectures will be given in 309 Havemeyer Hall on Tuesday afternoons at 4:30, and will be illustrated.

November 12—Rear-Admiral C. F. Goodrich, U.S.N.: Introductory Address.

November 12—Lieut.-Commander W. S. Crosley, U.S.N.: "Dead Reckoning and Coastwise Navigation."

November 19—Lieut.-Commander W. S. Crosley, U.S.N.: "The Bottom of the Sea and its Uses in Navigation."

November 26—Lieut.-Commander R. H. Leigh, U.S.N.: "Deep-sea Navigation: Latitude."

December 3—Lieut.-Commander R. H. Leigh, U.S.N.: "Deep-sea Navigation: Longitude."

December 10—Professor Poor: "The Sun and its Motions."

December 17—Professor Poor: "The Making of an Almanac."

January 14—Dr. R. A. Harris: "Tides: their Characteristics, Observation and Prediction."

January 21—Dr. R. A. Harris: "The Causes and Representation of the Tides."

January 28—Dr. R. A. Harris: "Tidal Currents and Meteorological Tides."

February 4—"How Charts are made and used." Lecturer to be announced.

February 11—Dr. L. A. Bauer: "The Magnetic Survey of the Pacific Ocean by the Carnegie Institution."

February 18—Professor Hallock: "Finding the North Magnetic Pole."

February 25—Capt. Howard Patterson: "The History of the Compass and its Errors."

THE Reed collection of heads, horns and skins of Alaskan big game animals, which for three years has been on exhibition at the Union Club in Victoria, B. C., has been secured for the New York Zoological Park. The collection was formed by Mr. A. S. Reed, an English sportsman, during an extensive series of hunting adventures in the northwest, and contains the finest lot of heads of giant moose, caribou, Alaskan brown bear, white mountain sheep and walrus ever brought together. Owing to the disappearance of the big game of Alaska, it is doubtful whether it would now be possible for any one to bring together such a collection of extra large specimens. Several of the objects are, by experts, believed to be the finest of their kinds in existence. The collection is widely known among the sportsmen of America and Europe. It arrived at the Zoological Park on October 16, and was temporarily stored in the horn room of the lion house. The collection was secured through the efforts of Dr. W. T. Hornaday, who last winter was instrumental in founding the National Collection of Heads and Horns, owned by the New York Zoological Society. It comes to New York as the gift of Emerson McMillin, Esq., a prominent member of the Camp-fire Club of New York.

The collection is valued at \$10,000; but by reason of the purpose to which it will be devoted, it was finally acquired at a total cost of \$5,500. It was secured barely in time to forestall its sale abroad. A German sportsman passed through New York City on his way to Victoria to purchase the collection, when he learned that it had been secured two weeks previously by the authorization of Mr. McMillin.

Nature states that a meeting of the International Meteorological Committee was held at Paris on September 10 and following days. The committee consists of seventeen members, appointed at the conference at Innsbruck in 1905. Ten members were present, including the director of the Japanese service. Two places were vacant by death. The principal subjects discussed were the scheme of organization of international meetings for meteorological purposes; marine charts and weather signals; a number of items of the international daily weather service, including reports by wireless telegraphy; and various propositions concerning the meteorology of the globe, in which were included one on the necessity for observing stations in the regions of centers of action of the atmosphere, another on the necessity for new charts of isotherms for the globe, and a third on the desirability of daily observations from selected stations, in order to trace the course of meteorological changes over the globe. A number of special commissions were appointed to report upon, or carry out, the various proposals. M. Mascart, president of the committee, was unfortunately prevented by illness from attending the meetings with the exception of one held at his house for the discussion of the question of international organization. At the close of the session he resigned the office of president, and Dr. Shaw, director of the British Meteorological Office, was elected president. M. Angot, M. Mascart's successor at the Bureau Central, takes his place also as a member of the committee. Dr. Hellmann, director of the Prussian Meteorological Institute, was elected secretary, in succession to Professor Hildebrandsson, who retires upon his withdrawal from the post of director of the Royal

Meteorological Observatory at Upsala. Dr. Hamberg, director of the Swedish Meteorological Office, was elected to succeed Professor Hildebrandsson as a member of the committee. The other vacant places were filled by the appointment of Dr. Maurer, director of the Swiss office, and Mr. Stupart, director of the Canadian office.

THE lime produced in the United States in 1906 amounted to 3,197,754 short tons, valued at \$12,480,653, an increase over the production for 1905 of 213,654 tons in quantity and of \$1,130,425 in value. The average price per ton in 1906 was \$3.90, against \$3.67 in 1905, an increase of \$0.23. These figures are reported by Mr. E. C. Eckel, in an advance chapter from "Mineral Resources of the United States, 1906," published by the U. S. Geological Survey and now ready for distribution. The distribution of the production by states shows that Pennsylvania, with 624,060 tons valued at \$1,857,754, has first place, its nearest competitor being Ohio, with 331,972 tons valued at \$1,100,133. Maine, Wisconsin and Minnesota each produced more than 200,000 tons, with values approximating \$1,000,000; and Maryland, Illinois, Massachusetts, New York and Vermont follow in the order named, with productions of more than 100,000 tons. West Virginia, Alabama and Connecticut each exceeded 90,000 tons. The value per ton increased in almost every state, the producers giving as the cause the increased cost of fuel, supplies and labor. Of the total production, 2,647,724 tons were sold for structural uses as building lime, hydrated lime, for sand-lime brick manufacture, for slag cement, and for quick-lime brick; 550,030 tons were used in various chemical industries.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of Robert N. Carson provides for the establishment of an industrial school for girls at the death of Mrs. Carson. The school, which is to be on the model of Girard College, will, it is said, have an endowment of five million dollars.

A FELLOWSHIP in physics of the value of \$500 annually has been established at the University of Cincinnati in memory of the late

Henry Hanna, of Cincinnati, who was the giver of one of the university halls. The foundation was made by his widow and daughter.

A COLLEGE OF MEDICINE, in which for the present only the first two years of the medical course will be given, has been formally organized at the University of Wisconsin. The entrance requirements include at least two years of college work. There are specific requirements in Latin, French and German and in physics, chemistry and biology. Dr. C. R. Bardeen is dean.

DR. EZRA BRAINERD has resigned the presidency of Middlebury College, which he had held for the past twenty-three years, having been in all instructor, professor and president of the institution for forty-three years. Dr. Brainerd is known for his work on the geology of the Champlain Valley and the botany of Vermont. Dr. John M. Thomas, pastor of the Presbyterian church at East Orange, N. J., has been elected president of the institution.

DR. EMERY TAYLOR, associate in anatomy at the Wistar Institute of Anatomy, has been elected assistant professor of anatomy at Cornell University.

DR. F. W. THYRIG has been appointed Bullard Fellow in embryology at the Harvard Medical School, and will devote himself to researches on the anatomy of human embryos and on the comparative embryology of the pancreas.

MR. L. E. EMERSON, Ph.D. (Harvard), has been appointed instructor in philosophy in the University of Michigan.

PROFESSOR J. J. CHARLES has retired from the chair of anatomy and physiology at Queen's College, Cork, which he has held since the establishment of the college. The chair has been divided—Dr. B. C. A. Windle, president of the college, having been made professor of anatomy and Dr. David Barry, professor of physiology.

DR. LUDWIG BRUNNER, has been promoted to an associate professorship of chemistry in the University of Krakau, and Dr. Erich Marx, to an associate professorship of physics in the University of Leipzig.